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## EDITORIAL ANNOUNCEMENTS.

*THE BRITISH AND EASTERN CONTINENTS edition of the Railroad Gazette is published each Friday at Queen Anne's Chambers, Westminster, London. It consists of most of the reading pages of the Railroad Gazette, together with additional British and foreign matter, and is issued under the name Railway Gazette.*

*CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.*

*ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

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VOL. XL., No. 24. FRIDAY, JUNE 15, 1906.

Most of the history of rail motor cars up to the present time has been written in England, where these cars, on a number of short services, have been able to run with considerable regularity, although the economy of their working has been questioned. But in the current issue of the *Railroad Gazette* Mr. W. R. McKeen, Jr., Superintendent of Motive Power and Machinery on the Union Pacific, gives a most entertaining account and diary of the seven gasolene cars which have been built by that company at its own shops. These cars are mostly at work on regular services. Numbers 1 and 2 each make a round trip daily on the branch between Kearney and Callaway, Neb., 65 miles. Car No. 3 is in regular service on the Southern Pacific between Houston and Galveston, Tex., 57 miles. Car No. 4, after temporary service on the Kearney branch, is now running on the Oregon Railroad & Navigation Line out of Portland, Ore. Car No. 5 is running out of Los Angeles, and car No. 6 is running between Leavenworth and Lawrence, Kan., making a round trip of 68 miles daily. Each of these runs is considerably in excess of what has been required of motor cars in Great Britain, but most interesting of all has been the preliminary education of the car, its grand tour after it graduated from the shops and before it settled down to its life work. Car No. 1 ran under its own power from Omaha to Portland, Ore., and return. Car No. 2 took out most of its education in speed runs; No. 3 went under its own power from Nebraska to Texas; No. 4 ran from Omaha to Oregon, and No. 5 from Omaha to Los Angeles. No. 6 seems to have been a stay-at-home, but the most recent graduate from the Omaha shops, Car No. 7, came from Omaha to New York, and is now running on the Erie. Except for faster time, better hill climbing power and stronger endurance than was anticipated, these extraordinary gasolene motor runs seem to have been quite without incident, and they demonstrate what can be done by good engineering work in a new field, without any previous experience to serve as a guide, except that derived from the skilled and tireless labors of the manufacturers of automobiles.

Mr. H. V. Wille, Assistant to the Superintendent of the Baldwin Locomotive Works, makes, on another page, an exhibit of the Vauclain four-cylinder compound locomotive, its present design, its accomplishments compared with simple locomotives, and its rapidly increasing use. It is probable that we should not have been obliged to wait until this late date for this evidence had it not been for the fear of conservative men of anything that has a suspicion of complication, to which was added the traditional unreliability of the crank axle for heavier work than is required in British practice, and as it was made in the old days of the inside-connected engine when we had neither the manual skill nor the tools wherewith to make such an axle properly. All this has now been overcome, and reports from every quarter are practically unanimous in confirming the claims of Mr. Wille's paper that a crank axle can now be made which is fully as reliable as a straight one. The figures given are significant. The actual number of compound locomotives of the Vauclain type (281) that have been built or which are in course of construction, is not large. We have not the data at hand, but it is probable that eight or nine years ago the same makers had a larger number of compound locomotive engagements on their books. The difference and significant part of the matter is that at that time compound locomotives were being urged on the railroads by the arguments of the builders; whereas, at present, the initiative comes largely from the railroads. This shows that the value of the system has won out in the fight with the simple engine. We hear comparatively little of late of the cross-compound. Possibly because it is an old story, but also probably because it soon found its limitations in the later growth of the locomotive by which such excessively large low-pressure cylinders were required that they were debarred by the limits of the permanent way. So the four-cylinder machine has been adopted from European practice, and it now remains to be seen whether the compound in this form can win against a simple engine with a superheater or whether the final stage of the development will be in the form of a four-cylinder compound with a super-heater. That there are other minor advantages inherent in the type there can be no doubt, for it appears from results obtained on the Danish State Railways that there will be a marked difference in the rate of wear of the driver tires, and we all know of the greater ease of riding. Mere ease of riding would in itself receive but scant attention did it not mean also decrease of strain on track and engine. The power development is also up to the modern requirements, and the amount of steam used

satisfactorily low. It appears, then, that these points are appreciated by railroad officers and that they are now asking for these engines, instead of receiving them under protest, as so often happened ten years ago.

## FLAT WEAR OF DRIVING WHEEL TIRES.

Flat wear of driving wheel tires on two-cylinder locomotives is an incurable evil under usual conditions of service. It is one of the several inherent deficiencies of the mechanism that are beyond the power of the designer to overcome. That the trouble can be mitigated to a certain extent has been proven by the experiences of the many who have investigated the matter with the hope of applying an effective remedy. But the action is the natural result of a given set of physical conditions and will persist so long as the conditions are unchanged. This has been pretty generally accepted by motive power men in a spirit of resignation to the inevitable ever since the elaborate investigations made some ten years ago and summarized in a report to the Master Mechanics' Association. However, now and then a road which suffers excessively in this respect undertakes anew an investigation of the matter in an effort to correct the difficulty. An instance of this sort which lately occurred on a well-known road is of particular interest because of the care and thoroughness with which the study was prosecuted (it extended over a period of two years) and for the reason that it illustrates convincingly the fruitlessness of efforts to correct entirely the trouble.

In order to ascertain accurately how this wear was occurring on the wheels of different locomotives, a special gage was made and each roundhouse given one. This gage was designed to fit into the center of the wheel and to be so rotated that a sliding indicator, which was kept a uniform distance from the flange of the wheel, would trace a diagram which would be a correct reproduction of the worn condition of the tire. An immense number of these diagrams were made from different engines of different classes and from the same engines at different times. The results, however, showed little regularity. In fact, so contradictory were they as to lead to the belief that the wear was seriously affected by improper counterbalance.

To determine the correctness of this view, instructions were given to weigh every individual driving wheel of every locomotive passing through the shops for general repairs and carefully check the counterbalance. The records were kept by the general foremen and furnished absolute knowledge of the counterbalance of every individual wheel; also they assured that it was correct and uniform for each class. This having been done, further wearing diagrams were taken with the gages. The results were just as irregular as before. Needless to say, at the present time the investigators are if anything more puzzled about the matter than ever.

One thing that has been observed by different investigators of irregular tire wear, and by some referred to as most peculiar, is that the handling of certain locomotives by certain enginemen affects the results favorably or otherwise as the case may be. The Master Mechanics' report already referred to gave as the reason for this the slipping of the drivers at starting of heavy trains by careless enginemen. In fact, the larger part of the wear was said to be due to this cause.

In the April number of the Bulletin of the International Railway Congress, Mr. O. Busse, Locomotive and Rolling Stock Superintendent of the Danish State Railway, gives some figures on the relative wear of tires on inside and outside cylindered engines. The designs were practically alike except for the cylinder arrangement, the weights and dimensions being the same. After 18 months of service, according to the figures given, the inside-cylindered locomotives averaged 93 per cent. greater mileage between tire turnings for practically equal amounts of wear. The natural conclusion of Mr. Busse is that the inside cylindered locomotive, which is comparatively a new institution on his road, is very much more profitable than the other kind. Diagrams of the average wear on the main drivers are given and on that for the left wheel of the inside-cylindered locomotive a peculiar thing is noticed. All of the other diagrams show but one pronounced flat spot for each tire, but on the one in question there are three such spots of approximately equal depth: one corresponding to and in line with the similar spot on the right-hand wheel, which is about 10 deg. ahead of its crank and therefore 100 deg. ahead of the left-hand crank; the second being at the 225 deg. point, and the third at the 315 deg. point, or 45 deg. behind the crank. Mr. Busse does not refer to this in his paper nor does he offer any theory for the difference in wear between the two designs of locomotives. All of the drivers had Krupp tires made to the same specifications. However, according to the results obtained on the road first referred to in this article, this would not insure uniform results under similar conditions. This road has samples of tires of identically the same chemical analyses, some of which wore remarkably well and others very poorly. Yet upon being etched they showed plainly under the microscope a dense, solid structure in one case while in another the steel was of a spongy or porous nature. About the only conclusion reached in this road's tests was that a steel of the densest possible character and of great toughness is highly essential.

In connection with the comparative figures from the inside-cylindered locomotives on the Danish State Railway it is interesting to know what the results have been in this country with the balanced compounds. Inquiry of both the Burlington and Santa Fe discloses the fact that there has been no trouble from flat spots whatever. This, of course, means much greater mileage between tire turnings as compared with the two-cylinder locomotives.

## COMMITTEE WORK.

Committee work for the Master Mechanics' and the Master Car Builders' Associations is generally a misnomer, as the reports are really papers by the nominal chairmen of the respective committees. Occasionally it happens that all the members assist in the work of research or compilation, but more often the proceeding is something like this: The chairman of the committee draws up a circular of inquiry; this is sent to the other members of the committee for their suggestions, or approval—generally approval without suggestions; the secretary sends out this circular, and a small number of the members reply. These replies are sent to the chairman, who compiles the few answers turned in, and composes the document; the committee reads, and again says "O. K.," or sometimes nothing, and the work is done.

It is fair to say that this is not always the case, but it is reasonable to assume that the formula obtains in at least 50 per cent. of the committee reports. There is a cause for this, however, and the reasons are fairly good ones. Members of the committee are supposed to be chosen on account of their particular ability to treat some special subject, because of particular study which they may have given to the matter, or to the general interest which they may have exhibited. So far, this is good and proper, but such members are apt to be separated by a thousand miles or more, and cannot get together conveniently for conference, which adds so greatly to the interest of their work. The chairman is therefore left practically to himself. The press of business in the ordinary railroad position is so great that this work is generally left until the last minute, and then it is very difficult to get the members together or for them to take time properly to consider the report prepared by the chairman. Sometimes minority reports are submitted, or sections of the reports prepared by the different members, but ordinarily the "good old way," as outlined above, becomes the standard method of operation. If this work is done by the chairman, he should get the credit (whatever that may mean) for the work performed, but this is always assumed to be equally divided.

The old time report of scheduling eighteen or twenty questions and the answers (like the early school book) seems, happily, to have passed. It was too much like this:

*Question.*—What experience have you had with such a device?

*Answer.*—Twenty roads replied to this question. Fifteen had no experience; two had it on one engine, but it was no good; three have it now on trial, but have not yet made up their minds as to its value.

When this was repeated eighteen or twenty times, and the whole thing read over slowly and impressively in convention, it was no wonder that members went to sleep—or wished they could!

A report should state concisely the purpose of the investigation; the general amount of information available or contributed; an expression of the views of the majority of the authorities and the deductions and recommendations of the committee. If long dissertations are needed in order to fully explain the subject, they should be placed at the end, in the form of an appendix, and not in the main body of the report. The presentation of the paper is also of great importance, as the matter is now printed and distributed to the members considerably in advance of the meeting, it is wearisome to have a long report read through verbatim, and if in drawing up the report some prominent features could be put together in a paragraph, or in such shape that they could easily be separated from the main body of the discussion, it would permit of a ready

means of abstracting and giving the principal points to the convention in a minimum amount of time, and allow the bulk of the time for a discussion which may be more or less animated. When a long paper is read through and the members have previously gone through the same document, they are apt to be so tired by the time the reading is finished that there is little life left to properly discuss the features presented; particularly if the morning be warm and if the dinner hour be approaching. It is hoped that the coming conventions will conduct their business more upon the lines suggested and reduce as much as possible the labored reading through of voluminous reports.

## THE INDIVIDUAL EFFORT AND PIECE-WORK SYSTEMS.

Much has been written and said of late concerning the comparative merits of the individual effort or bonus system and the piece-work system of operating railroad shops, and a brief review of the points for and against each system may be opportune.

Under the individual effort system a standard time is set for doing each piece of work, based on a record, kept to fractions of a minute, of the time required by a competent workman to do the same. In this and many other particulars it agrees closely with piece-work, but it differs essentially in two features: (1) It guarantees to each man his day rate of pay even though he may do less than the standard amount of work, and (2) for each succeeding piece done in excess of the standard day's work the price per piece is increased by arithmetical progression, which offers an extra inducement for a man to increase his output up to the very limit of his capacity. A clear idea of the working of the individual effort and piece-work systems as compared with day-work, can best be given by illustrating with an example in which we will take a man whose day rate is 20 cents an hour, engaged in planing driving box wedges, for which the piece-work or individual effort price has been fixed at 20 cents each. The man's earnings and the cost of the work under the various systems will be as follows:

| | Day work | | Piece work | | Individual effort system | |
|---|---|---|---|---|---|---|
| | Cost, total. | Cost, per piece. | Cost, total. | Cost, per piece. | Cost, total. | Cost, per piece. |
| 6 wedges | $2.00 | $0.333 | $1.20 | $0.20 | $2.00 | $0.333 |
| 8 " | 2.00 | .25 | 1.60 | .20 | 2.00 | .250 |
| 10 " | 2.00 | .20 | 2.00 | .20 | 2.00 | .200 |
| 11 " | .... | ... | 2.20 | .20 | 2.225 | .202 |
| 12 " | .... | ... | 2.40 | .20 | 2.475 | .206 |
| 13 " | .... | ... | 2.60 | .20 | 2.750 | .212 |
| 14 " | .... | ... | 2.80 | .20 | 3.050 | .218 |
| 15 " | .... | ... | 3.00 | .20 | 3.375 | .225 |
| 16 " | .... | ... | 3.20 | .20 | 3.725 | .233 |

In this example the day-work cost has not been extended beyond $2, because the price under the piece-work and individual effort systems has been based on an output which is slightly greater than the average obtained by day-work.

A prominent exponent of the individual effort system, writing in an engineering journal recently, itemized the good points of this system as follows:

1. "The standard time set is reasonable and one that can be reached without extraordinary effort, is in fact such time as a good foreman would demand.
2. "An extra reward of one-fifth of the regular wages for the operation is given to whoever makes standard time.
3. "Extra compensation above the hourly rate is paid even if standard time is not reached, although this extra compensation diminishes in percentage above standard time-and-a-half.
4. "If longer than time-and-a-half is taken, the regular day-rate is paid. Of this, the wage-earner is also sure.
5. "Standard time is carefully determined by observation and experiment, and is only changed when conditions change.
6. "The arrangement is one of mutual benefit to both parties—of increased earning to the worker, of increased saving to the employer.
7. "The employer loses more than the wage-earner if schedules do not encourage co-operation.
8. "The wage-earner, working on a schedule, becomes in a large degree his own foreman.
9. "The wage-earner determines his own earning power, and by co-operating to cut out wastes increases his own value."

Now, let us see to what extent these same claims apply to modern piece-work, and in so doing it should be borne in mind that the up-to-date piece-work practice of the present day is quite different from that of twenty, or even five, years ago.

1. The present method of making piece-work prices is practically identical with that described for setting the "standard time" for a job under the individual effort system.

2. The piece worker also obtains extra pay for increased efforts.

3. This differs from the piece-work practice under which no extra compensation is paid until the work is turned out in what may be considered as standard time.

4. Here again piece-work differs, in that a man is paid for the actual amount of work performed, and if this does not come up to the average, his earnings will drop below his day rate.

5. If we use the word "price" instead of "time," this statement applies with equal force to piece-work.

6. This claim applies with equal force to piece-work.

7. In this respect piece-work differs because it is equally advantageous for the employer and the wage-earner to have the schedules fair and equitable to both.

8 and 9. These claims are also equally true of piece-work.

Advocates of the individual effort system admit that "nothing compels the employee to make standard time," which may be understood to mean that it permits the lazy and incompetent workmen to hold on to their job indefinitely, whereas such men soon voluntarily leave a piece-work shop. The matter of making prices and keeping a record of the earnings is somewhat more complicated under the individual effort system than under the piece-work system. Either of these systems will mean for the employer better men, better work and more of it, and for the employee they will mean better pay and, as a rule, steadier work than under the day-work system. A comparison of the pay-rolls of day-work with piece-work and individual effort shops will show that the average earnings for the two latter are between 15 and 40 per cent. higher per hour than for the day-work shops, which is a practical refutation of the claim commonly made by opponents of piece-work that it is a scheme for reducing wages.

Some of the claims made by advocates of piece-work in favor of their system as compared with the individual effort system are that supervision costs less in proportion to output; that it is simpler and more easily comprehended by the workmen, and is less expensive to install and check up. We see no grounds for advocates of either system claiming any advantage over the other in the matter of stimulating ingenuity and head-work on the part of the workmen, and, in fact, the term "individual effort" is as accurately descriptive of the modern piece-work system as it is of the "premium system" by which it has been appropriated.

To sum up, the two systems agree in most of their essential features; both are beneficial and absolutely fair to the employee, and at the same time advantageous to the employer; but the guaranteed day rate and more euphonious name may make the individual effort system more attractive and therefore easier to introduce in shops which have hitherto been run exclusively on a day-work basis.

## LOCOMOTIVE PERFORMANCE STATISTICS.

The committee of statistical inquiry of the American Railway Association has at last presented a report that is intended at least to make a closer comparison of locomotive performances than has been possible under the conditions of compiling these statistics that have heretofore existed. The report, as it stands, must, however, be considered merely as a report of progress, for, in the opening paragraph, it calls attention to a previous report in which an opinion was expressed that a further index of efficiency is desirable, in the form of ton-miles per unit of tractive force, and that it had under consideration a method of adapting the same to the form submitted. It begs leave to state that the experimental tests which it considers necessary, before submitting such further index, have not yet been completed, and it is, therefore, not prepared to report on this branch of the subject at this time.

A valuable feature of the report is the fact that it divides the responsibility for engine delays between the motive power and the transportation departments, so that if there is a scarcity of power, the responsibility can be definitely placed either upon the motive power department for not having the engines ready for service; the transportation department for delays upon the road or in the roundhouse; or, these two acting with full efficiency, upon the management, for not providing sufficient power to do the work. The motive power department is held responsible merely for time consumed in engine house movements and in making repairs; the transportation department shoulders all of the rest, barring, of course, engine failures on the road.

In order that the working efficiency of the engines may be completely understood, the time is distributed among the passenger, freight, switch and work service so that there is no lumping of the whole, and thus allowing exceptionally good work along one line to leaven and conceal something perhaps decidedly bad in another.

What should constitute engine mileage has been a point of dispute for years. Should an allowance be made for movements between the roundhouse and the terminal station or yard? What should be credited to local freight engines for switching at station stops and what mileage should be attributed to switching engines? How is the mileage of work engines to be computed? All these items were causes of disagreement, and though the disagreement was often slight, it was quite enough to make considerable variation

in the results, and by the very fact that there was a possibility of a variation in the basis, a doubt was cast over each and every collection of these statistics because it was not certain how they were constructed.

The new form proposes that the mileage of passenger engines shall include such items as helping mileage, light mileage between terminals and light mileage between engine and train terminals. The conditions are practically the same for freight service. In the switching service there is a marked departure from previous standards. It will be remembered that on May 8, 1903, Mr. George L. Fowler published in the *Railroad Gazette* the results of an investigation of the mileage made by switching engines in service. The figures then given showed that in no case did a switching engine in freight service make more than 2.86 miles per hour, and that in passenger service, 3.27 was the highest average speed obtained, though these figures dropped to 2.52 and 3.07 miles per hour, respectively, when the time at water and coaling stations was not subtracted from the total time out of the roundhouse.

When these figures were presented to the Master Mechanics' convention in June, 1903, there was a protest that they were too low, although there were observers present who were ready to corroborate them. The established rate of six miles an hour was upheld by those in authority as being low enough. The following quotations are from remarks made at this 1903 convention:

"So far as mileage for switch engines is concerned, I personally think that the six miles is entirely too low for our modern locomotives, weighing 140,000 to 150,000 pounds on the drivers, that will haul double the tonnage of locomotives of 60,000 and 70,000 pounds on the drivers. To figure them on the same basis would be inconsistent." "This committee says that for strictly yard work, four miles an hour for passenger switchers and 3½ miles for freight switchers would undoubtedly be a liberal allowance." "I believe any one who has watched the expense of switching locomotives of heavy type, will agree with me that the switching locomotives prove to be the most expensive locomotives we have to maintain of a heavy type."

"I am thoroughly convinced that the mileage is too low at present on the heavy locomotives. The cost is running up on them and the mileage we are getting out of flues and tires is running down, and if any change is made, the mileage should be raised." "In my opinion, it would be ridiculous to consider anything less than six miles an hour."

The discussion ended in a resolution to refer the matter to the committee of statistical inquiry of the American Railway Association, and this committee now recommends that the mileage of switching engines in the yard and of road engines when switching at stations shall be computed at the rate of three miles per engine-hour, which is undoubtedly quite high enough and as close as accuracy as any convenient general average can be made.

The report then recommends a basis of comparison that is a novelty, and must be tried out in practical work before it can be unequivocally sustained. It is the reduction of the mileage as already determined to that of an equivalent mileage of an engine having 25,000 lbs. tractive force which is adopted as a standard. This is obtained by reducing the sum of the products of the mileage of each engine by the ratio of its tractive force as determined by the following formula, to that of the Standard Engine:

$$T = \frac{d^2 \times S \times .8\, p}{D},$$

T = tractive force in pounds;
d = diameter of cylinder in inches;
S = stroke of piston in inches;
p = steam pressure in pounds;
D = diameter of driving wheels in inches.

There is nothing peculiar about the car or train mileage except that there is a separation of the empty and loaded freight car mileage.

In ton mileage, that of the passenger service is reduced to its simplest form of multiplying the mileage by the weight of the car; but in freight service there is a call for the total revenue ton miles, the total ton miles of lading, the total ton miles of cars and lading, and the same total for engines, cars and lading, with a final adjustment of the weight of each car and its lading plus car allowance factor (determined for each division) multiplied by the mileage of the car. This car allowance factor is to compensate for difference in resistance, owing to the various weights and number of cars in a train, as determined by dynamometer tests or otherwise. Finally, there is to be an adjusted ton mileage of the total engine capacity, that is to say, the sum of the miles made by each engine multiplied by its maximum capacity expressed in adjusted tons. Under the head of averages there are twenty-two items that cover a wide range of ratios between the several factors that have been determined, ending in the tons per standard engine, which includes passenger cars, revenue freight tons, revenue and company freight, cars and lading, passengers per car, tons per loaded freight car and the engine capacity utilized in freight service.

To compile a report along these lines will certainly require care and an elaboration of a quick working organization in order that it may be of real value to the manager and the superintendent. That it will have enough value to warrant such an organization, there is probably no doubt. It is evidently the result of a long and painstaking piece of work on the part of the committee, and is a strong corroboration of the assertion of Mr. Priestly in his report on American Railroads to the effect that the American manager lives in an atmosphere of statistics, by which all the inter-relations of the properties that he managed are shown in as nearly their true relations as it was possible to bring them.

## NEW PUBLICATIONS.

*High-Tension Power Transmission.* New York: McGraw Publishing Co. Cloth; 6x9 in.; 315 pages; 114 figures. Price, $2.50.

This book contains a series of papers and discussions which were presented at the International Electrical Congress held in St. Louis in 1904. As these papers are by different authors and represent the results of practical working and observation in the field, there is naturally little or no connection between them other than that they cluster about and are based upon the general broad principles of the work which they represent, with such variations of detail as would naturally arise from diversity of operating conditions and the standpoint of the observer. They thus cover "various phases of the subject considered from various points of view," but this very diversity is valuable to one who wishes to study the subject at first hand, and it is safe to say that it is upon those very points where the greatest diversity exists that the most light is needed.

In all there are 17 papers, with the following titles: Electrical Power Transmission; The High-Tension Transformer in Long Distance Power Transmission; Notes on Experiments with Transformers for Very High Potentials; High Potential, Long Distance Transmission and Control; American Practice in High-Tension Line Construction and Operation; Spark Distances Corresponding to Different Voltages; The Use of Aluminum as an Electrical Conductor; Conductors for Long Spans; High-Tension Insulators; The Construction and Insulation of High-Tension Transmission Lines; Some Difficulties in High-Tension Transmission and Methods of Mitigating Them; Pioneer Work on the Telluride Power Company; Bay Counties Power Company's Transmission System; Some Practical Experiences in the Operation of Many Power Plants in Parallel; Maximum Distance to Which Power Can Be Economically Transmitted; Some Elements in the Design of High-Pressure Insulation; Insulating Materials in High-Tension Cables.

In the course of these papers there is a very complete resumé of the steps that have been taken in the development of the present methods of high-tension transmission from the early conditions in 1876, when, at the Centennial Exposition, there was a dynamo which could supply one arc lamp up to the beginning of the last decade, when there were practically no transformers in commercial service of a capacity as great as 100 kilowatts, or of a voltage exceeding 10,000, and so down to the present day, when there are approximately 10,000 transformers in America "with capacities ranging from 100 to 2,500 kilowatts and wound for pressures of from 10,000 to 60,000 volts," with possibilities and experience capable of handling 80,000 volts. So the subject of poles, insulators, conductors and the other items of construction are handled by men working in the field, and all are thus brought together in a form readily accessible for reference and consultation, making a volume that cannot fail to be of great value to the student, the investigator and the engineer.

*The Engineering Experiment Station of the University of Illinois.* By L. P. Breckenridge, Director of the Engineering Experiment Station. Urbana, Ill.: Published by the University.

This is Bulletin No. 3 of the University of Illinois Engineering Experiment Station. It describes briefly the plan of organization and the work already accomplished, giving a list of the publications so far issued, with a brief statement regarding the ground covered by each. The character of the work to be undertaken forms the subject of a section, and the titles of some of the most important investigations which have been submitted for approval of the station staff are listed under the various departments in which they would be made. The larger part of the Bulletin is devoted to the facilities for investigation available for this work. This is, of course, the equipment in the various departments of the College of Engineering. The descriptions are supplemented by a large number of half-tone engravings from photographs. The industrial interests of the state of Illinois are touched on under the four heads of Agriculture, Coal and Mining, Transportation, and Manufacturing. In closing, reference is made to the evident desirability of co-opera-

tion with similar state experiment stations and certain of the Government departments.

*The Adjustment of the Engineer's Transit and Level.* By Howard C. Ives, C.E., Assistant Professor of Civil Engineering, University of Pennsylvania. New York: John Wiley & Sons. Boards, 4¼x6¾ in.; 15 pages; 11 figures. Price, 25 cents.

This small book deals with one of the little things that is apt to be overlooked in the training of an engineer. It opens with a brief description of the several parts that must be considered in the adjustment of the level, such as the bubble tube, reticule, line of collimation, and vertical axis, all of which are defined and their functions explained. Then follows explanation of the method of adjustment of the Y level. This is illustrated by figures. The explanation is clear but could be rendered much easier to follow by the use of reference letters on the figures by means of which the various lines could be detected at a glance without requiring the mental effort of remembering the definitions. The same general method is followed in the case of the transit though the criticism regarding the reference letters on the figures does not hold. The book cannot fail to be of value to young engineers. It would be well for all such to follow the rule laid down by the author in the matter of his own students, in that he has them "actually make nearly all the adjustments rather than simply to test them without touching the screws."

*Directory of Directors in the City of New York.* 1906. The Audit Company of New York, 43 Cedar Street. Price, $5.

The eighth annual edition of the Directory of Directors contains the names of over 24,000 directors, each director's name being followed first by the name of the firm or company with which he is directly associated and then by all the companies of which he is a director. Selected lists of corporations in banking, insurance, transportation, manufacturing and other lines of business, alphabetically arranged, accompanied in each case by the names of company's officers and directors, are given in the Appendix. This is a very convenient kind of a directory to have. Like the telephone book, it furnishes a rough selection, but a pretty good one, of the people one is apt to want to find, and, unlike the telephone book, it gives many additional facts about them and their interests. It is a book of 1,017 pages and is well worth its price to a New York business or professional man.

*Poor's Railroad Manual, Appendix and Diary;* Containing Poor's Ready Reference Bond List, Dividends Paid, Annual Meetings, etc. Special edition of February, 1906.

The new matter contained in this very convenient publication is the record of annual meetings and other corporate dates of railroad companies, and of gross earnings, month by month. Apart from this, however, there is a most valuable compilation of facts about the operation and finance of the properties included in Poor's Manual, but brought up to the close of 1905. As the Manual, containing this same information rather more elaborated, does not appear until November, the present appendix is in reality a presentation of the essential facts of the Manual six months ahead of time, and is therefore most acceptable. It is also noteworthy that an effort has been made, we believe, for the second time by the present publishers, to collate the street railway statistics, imperfect as they necessarily are, that are contained in Poor's Manual for 1905. These are not revised up to December 31, and are therefore somewhat old as presented, but the presentation is in useful and convenient form. The table of gross earnings of the leading railroads, month by month, from January, 1900, through December, 1905, is of great and unique value.

## CONTRIBUTIONS

### The Freight Car Movement on the New Haven.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Your note of May 25 concerning demurrage on the New Haven road seems to call for a word from the "other side." The trouble of 15 months ago rested with the management of the road and not with the four-day rule or with the public. The public unloaded their cars then, as now, promptly or paid for the delay. But the public could not unload cars held in big yards 50 or 100 miles short of destination. There were thousands of cars so held on which the road was paying per diem of 20 cents, or penalty of $1 a day. As many of the cars so held were empties it was evident that the fault was not with the consignees. The public had good grounds for complaint; and if a reciprocal demurrage law had been in effect in Connecticut it would have cost the road a hundred thousand dollars, more or less, for the quarter ending March 31, 1905.

TRUTH.

[We have heard that an officer of the traffic department of the road complained to the operating department that consignees were being pressed so hard to unload cars that he (the traffic officer) was likely to suffer—that is, to have business taken away from him by such consignees. This would seem to confirm the view that the pressure had been somewhat strenuous. Where cars are delayed on the road an operating officer always does his best to move them. In pushing consignees he seems often to do less than his best.—EDITOR.]

### Tickets to Station Platforms.

New York, June 11, 1906.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I do not recall having seen mentioned in our railroad periodicals the convenient system used at the larger stations in Germany by which tickets of admission to the arrival and departure platforms which entitle the bearer to pass a train gate are sold by a slot-machine at a nominal price. These Bahn-Steig-Karte (please correct the German if wrong) would easily command a nickel at large stations in this country, and the revenue from them might go a long way toward paying station expenses. By using nickel-in-the-slot machines, the cost of the service is negligible. Perhaps American railroad managers fear to encourage petty thieves by the adoption of such a system, or it may be that our platforms are smaller in proportion to our train capacities than platforms are in Germany. But there must be some stations in the United States where this scheme would be both profitable and practicable.

R. W.

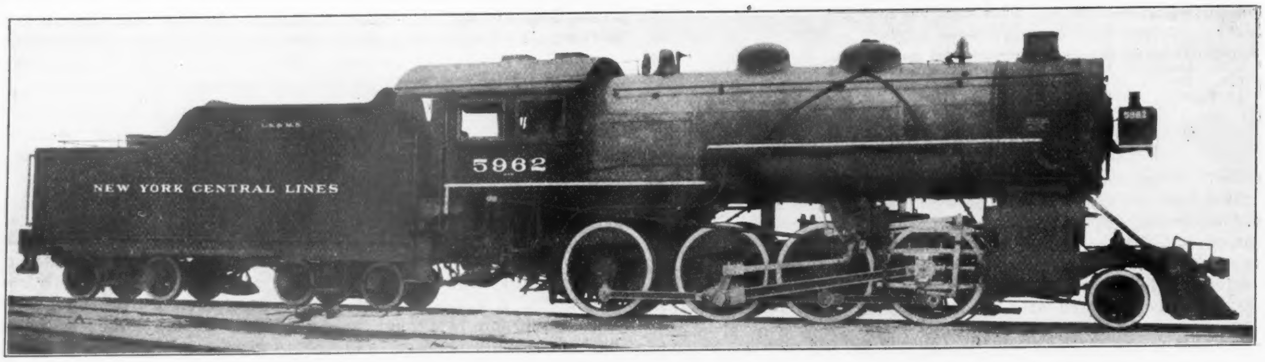
### Consolidation Locomotive for the New York Central Lines.

The American Locomotive Company has recently delivered from its Brooks Works 24 heavy consolidation (2-8-0) locomotives to the Lake Shore & Michigan Southern. Their general design is based on the types previously built for the New York Central, the Lake Shore, the Big Four and the Indiana Harbor. It is interesting as the standard type adopted by the New York Central Lines.

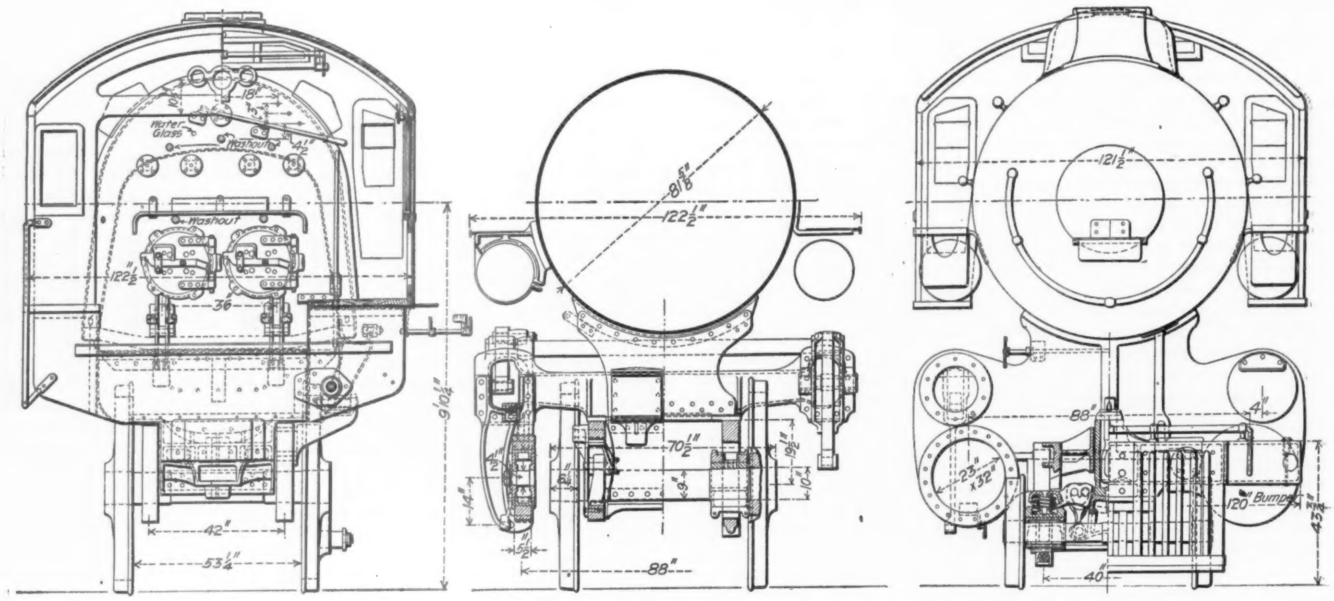
The weight of the engine is somewhat more than that of those earlier built, due to some slight modifications of details such as the use of cast-steel bumpers. A point to attract attention at once in the photograph is the use of the Walschaert valve gear. This is one of the notable innovations that seems to have established itself in American practice. It calls for some changes in detail to which our eyes are not yet quite accustomed. The reversing lever, as shown in the rear elevation of the engine, has its lower end in the form of a casting by which the lever itself is brought up well inside the cab and close to the boiler, while the reach rod is thrown outside the wheels and runs on an incline down to the end of the pendant lifting shaft lever. The arm of the lifting shaft lever extends back toward the cab and carries the hanger of the radius bar at its back end. The counter-balance cylinder is at the back end next the reverse lever instead of forward, as in the case of the link motion. A single heavy casting is used as a bracket for the bearings for both the lifting shaft and the link so that the whole is made not only very compact but exceedingly strong. This casting is bolted to the back of the guide yoke, which with it is provided with an opening for passage of the radius bar. The guide yoke itself is a strong steel casting of an I section that drops down from the frame brace on the outside of the guides and gives them the necessary vertical and lateral support. The valve is of the piston type, 14 in. in diameter, with a 5½-in. stroke.

At the front end there are several points of interest. The first is the location of the headlight, which has been removed from its position on top of the smoke-box to a bracket in front of the center of the shell. The reason for this is, of course, the height of the top of the boiler above the rails (13 ft. 4⁵/₁₆ in.), which necessitates the short external stack. This stack rises only 16½ in. above the smoke-box, not enough to accommodate a headlight. To make the headlight higher than the stack would not only be inartistic in appearance, even though clearances would permit it, but experience has shown that a headlight whose ventilator rises above the top of the stack has a bad effect on the draft; so bad, in fact, as to make the cab uninhabitable when the engine is running without steam. The short external stack is supplemented by an internal or lift stack which drops down into the smoke-box 23½ in. to a point just above the top row of tubes where the smoke-box flares to a wide bell-mouth, thus forming an unbroken extension to the stack above. The whole stack thus is 40 in. long.

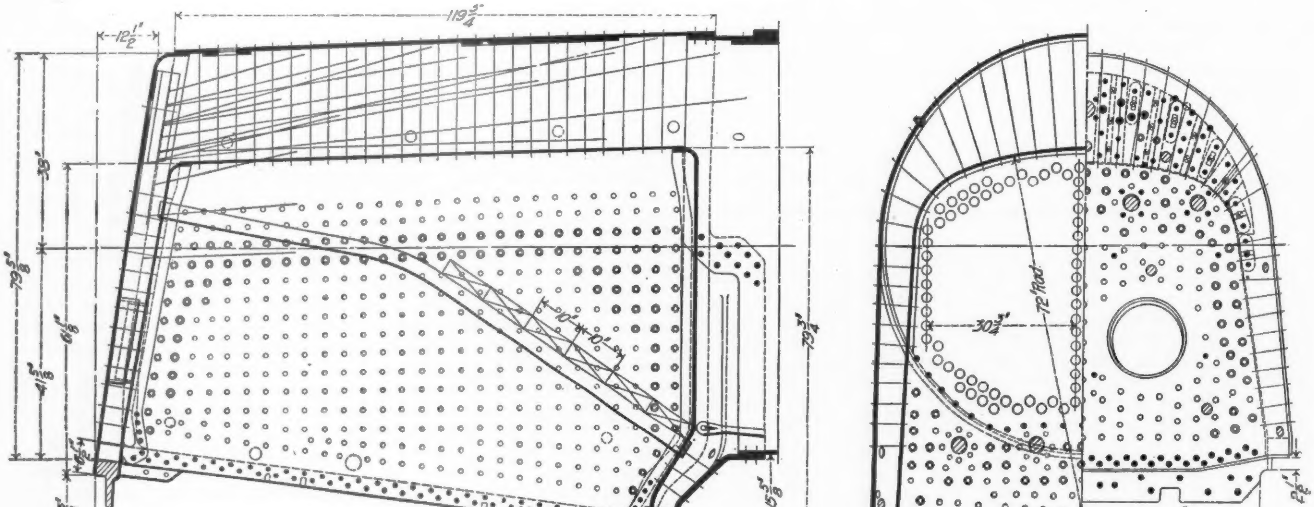
The method of fastening the smoke-box brace by the use of a pin and jaw on the buffer casting is simple and effective. So is the uncoupling device in which there is a rigid connection from the vertical arm on the main shaft to the bell-crank by which the lock is lifted. The pony truck is designed with helical carrying springs resting directly on the axle boxes and well protected by the housings in which they are placed. The truck is equalized with the two forward pairs of drivers instead of the front pair only, as in earlier practice. In this equalization and spring suspension the helical spring is freely used. It is over the truck boxes and at the ends of the equalization system for the two back pairs of wheels. Elliptics are used over each of the two forward pairs and between the two back pairs, or three on each side. This method



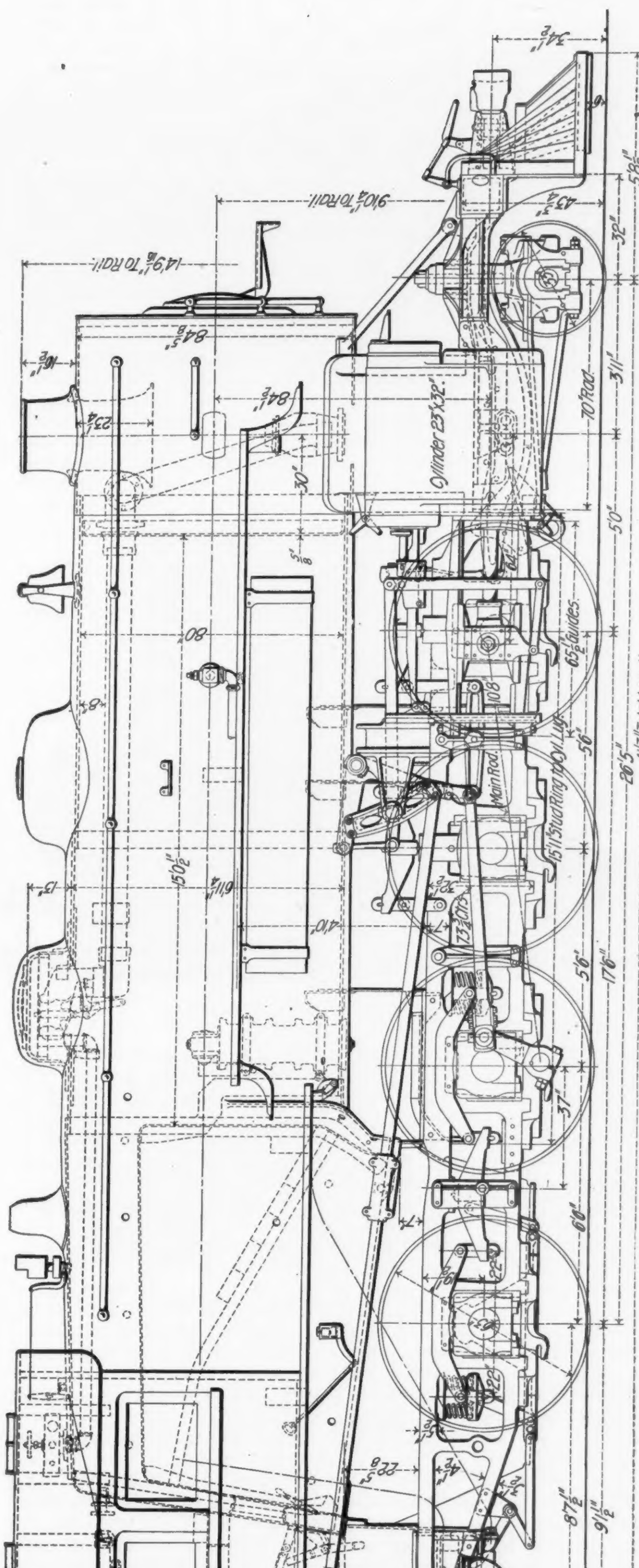

Consolidation Locomotive for the New York Central Lines, Built by the American Locomotive Company.




Elevations and Sections, Consolidation Locomotive for New York Central Lines.



Boiler and Firebox for Consolidation Locomotive, New York Central Lines.




Side Elevation of Consolidation Locomotive for New York Central Lines.

probably produces a mixed movement of the engine, as it were, compounded of the quick vibrations of the helical and the slow movement that would result if elliptics alone were used.

The Westinghouse-American driver brake is used, and with it an 11-in. Westinghouse pump and two brake cylinders of 14 in. diameter and 12 in. stroke. These cylinders are set vertically and are bolted to the front face of the frame brace at the guide yoke.

The locomotive cylinders are 23 in. in diameter, with a piston stroke of 32 in. dimensions, calling for the ample boiler capacity supplied. The boiler shell is 80 in. in diameter inside the smallest ring, and this with sheets 13/16 in. thick brings the top 13 ft. 2¼ in. above the rail with its center 9 ft. 10¼ in. above the rail. The allowable clearances that cut the height of the external stack down to 16½ in. put a similar limitation on the height of the dome, which rises only 13 in. above the shell, to which about 3 in. more should be added for the thickness and curvature of the cover. This cuts the available rise of the throttle valve down to 9¾ in. above the shell, to which point the standpipe for the turret also rises. The space between the highest point in the crownsheet at the front end and the inside of the shell is 21¾ in., so that there is an available distance of 31½ in. between the crown and the upper throttle valve opening, which is reduced by about 5½ in. for the lower. The three water gages are set 3 in. apart vertically with the lowest, 4½ in. above the crownsheet, so that with two gages of water in the boiler there is a distance of 18½ in. between the surface of the water and the lower opening of the throttle valve.

The boiler is straight-top. The firebox is fitted with a brick arch resting on circulating pipes extending from the tube-sheet to the back sheet of the firebox. The firebox itself is 7 ft. 5 in. wide outside, so that it comes well out over the driving wheels, and is provided with two fire-doors each 15 in. in diameter. It is carried, in accordance with current practice, by buckle plates which raise the mudring 7 in. above the frame at the front end and 23⅜ in. above at the back. The staying is radial and the Tate flexible staybolt is freely used at the sides and back. This staybolt is used in the two outside rows in the back head, as indicated by the double circles, and also in the two front and back rows of the sides, the third and fourth rows from the top longitudinally with a filling in at the corners as indicated on the drawing. The grate slopes forward and a shallow combustion chamber is formed by the dishing of the tube sheet.

This locomotive marks a notable advance over 25 years ago on the New York Central. At that time the standard freight and passenger locomotive was one having cylinders 16 in. x 24 in., and a boiler with about 1,175 sq. ft. of heating surface, carrying a steam pressure of 125 lbs. This latest engine has increased piston area 107 per cent., stroke 33⅓ per cent., heating surface 225 per cent., and steam pressure 60 per cent., so that the capacity of the engine to do work for each stroke of the piston has been increased nearly four and one-half times, thus somewhat outstripping the increase of heating surface.

The principal dimensions of the modern engine are as follows:

| | |
|---|---|
| Diameter of cylinders | 23 in. |
| Stroke of piston | 32 in. |
| Tractive power | 45,677 lbs. |
| Wheel base, total | 26 ft. 5 in. |
| " " rigid | 17 " 6 " |
| " " engine and tender | 66 " 9½ " |
| Weight in working order | 232,500 lbs. |
| " on drivers | 207,000 " |
| " engine and tender | 332,100 " |
| Heating surface, tubes | 3,492.12 sq. ft. |
| " " firebox | 185.64 " |
| " " arch tubes | 27.41 " |
| " " total | 3,705.23 " |
| Grate area | 56.5 " |
| Axles, main driving journals, diameter | 10 in. |
| " main driving journals, length | 12 " |
| " driving journals, diameter | 9½ " |
| " driving journals, length | 12 " |
| " truck journals, diameter | 6 " |
| " truck journals, length | 12 " |
| Boiler, outside diameter, smallest ring | 81⅝ " |
| Boiler, steam pressure | 200 lbs. |
| Firebox, length | 108⅛ in. |
| " width | 75¼ " |
| " thickness of crown sheet | ⅜ " |
| " " of tube sheet | ½ " |
| " " sides and back | ⅜ " |
| " water space, four sides | 4½ " |
| Tubes, diameter | 2 " |
| " number | 446 |
| " length | 15 ft. ½ in. |
| Exhaust | Single. |
| Smokestack, diameter | 20 in. |
| " height above rail | 14 ft. 9½ in. |
| Water capacity | 7,500 gals. |
| Coal capacity | 12 tons. |
| Valves, travel | 5½ in. |
| " diameter | 14 " |
| " steam lap | 1⅛ " |
| " exhaust lap | —— |
| " lead | 17-64 in. |
| Wheels, driving, diameter | 63 in. |
| Wheels, truck, diameter | 33 " |
| Weight on drivers ÷ tractive effort = | 4.53 |
| Total weight ÷ tractive force = | 5.09 |
| Tractive effort × diam. of drivers ÷ heating surface = | 776.64 |
| Heating surface ÷ grate area = | 6.56 |
| Firebox heating surface ÷ total heating surface = | .05 |
| Weight on drivers ÷ heating surface = | 55.86 |
| Total weight ÷ heating surface = | 62.75 |
| Volume of two cylinders = | 15.39 cu. ft. |
| Heating surface ÷ cylinder volumes = | 240.56 |
| Grate area ÷ cylinder volumes = | 3.67 |

### Program of the Master Mechanics' Convention, Atlantic City, N. J., June 18-20.

The sessions of the convention will be held in the sun parlor near the ocean end of the steel pier. There will be no hotel headquarters. The office of the President, Executive Committee and Secretary will be in the sun parlor. The Secretary will also have a desk in the office of the Enrollment Committee in the entrance to the pier.

Immediately upon arrival each member of the Association should report to the Secretary, register and receive his membership button, if he has none, and be furnished a properly numbered celluloid disc showing his registration. The members of the Association will also be furnished with badges for the members of their families. Cards for registration will be furnished at the Secretary's desk in the entrance to the pier.

Any members who have attended the M. C. B. convention should register again after the adjournment of that convention. It will only be necessary to register once for each convention.

OPENING SESSION, MONDAY, JUNE 18, 9:30 A. M. TO 1:30 P. M.

| | | |
|---|---|---|
| Prayer | 9:30 A.M. | to 9:35 A.M. |
| Address of President | 9:35 A.M. | to 10:00 A.M. |
| Intermission | 10:00 A.M. | to 10:05 A.M. |
| To allow those who wish to retire to do so, although all are requested to remain. | | |
| Action on Minutes of Last Meeting | 10:05 A.M. | to 10:10 A.M. |
| Report of Secretary | 10:10 A.M. | to 10:20 A.M. |
| Report of Treasurer | 10:20 A.M. | to 10:25 A.M. |
| Assessment and Announcement of Annual Dues | 10:25 A.M. | to 10:30 A.M. |
| Election of Auditing Committee | 10:30 A.M. | to 10:35 A.M. |
| Unfinished Business. | 10:35 A.M. | to 10:40 A.M. |
| New Business: | | |
| Consideration of matters pertaining to the Association; appointment of committees on Correspondence, Resolutions, Nominations, Obituaries, etc., and such other business as may be presented | 10:40 A.M. | to 11:00 A.M. |
| Reports of Committees on Shrinkage Allowance for Tires and Design of Wheel Centers | 11:00 A.M. | to 11:30 A.M. |
| Flexible Stay Bolts. | 11:30 A.M. | to 12:00 M. |
| Topical Discussion: | | |
| 1. Is not a boiler pressure of 185 lbs. better than 200 lbs. for locomotives. To be opened by Prof. W. F. M. Goss | 12:00 M. | to 12:20 P.M. |
| 2. The necessity of proportioning brake pressure to wheel loads. To be opened by Mr. Geo. L. Fowler. | 12:20 P.M. | to 12:40 P.M. |
| 3. Is it practical to use the Prosser tool in roundhouse running repairs? To be opened by Mr. F. R. Cooper | 12:40 P.M. | to 1:00 P.M. |
| Discussion of Individual Paper on Valve Gears for Locomtives. By Mr. C. J. Mellin. | 1:00 P.M. | to 1:30 P.M. |

Adjournment.

MIDDLE SESSION, TUESDAY, JUNE 19, 1906, 9:30 A. M. TO 1:30 P. M.

| | | |
|---|---|---|
| Discussion of Reports on Locomotive Tests of Penn. R. R. at St. Louis Exposition | 9:30 A.M. | to 9:45 A.M. |
| Water Softening for Locomotive Use | 9:45 A.M. | to 10:00 A.M. |
| Locomotive Front Ends | 10:00 A.M. | to 10:45 A.M. |
| Mechanical Stokers | 10:45 A.M. | to 11:00 A.M. |
| Classification of Locomotive Repairs | 11:00 A.M. | to 11:30 A.M. |
| Enginehouse Running Repair Work on Locomotives | 11:30 A.M. | to 12:00 M. |
| Topical Discussion: | | |
| 1. Grease *vs.* oil in driving box cellars. To be opened by Mr. F. H. Clark | 12:00 M. | to 12:20 P.M. |
| 2. (*a*) The relation of roundhouse to shop and road. (*b*) The best roundhouse organization for properly taking care of locomotives. To be opened by Mr. S. W. Miller | 12:20 P.M. | to 12:40 P.M. |
| 3. Distortion of wheel centers and tires out of round due to heavy counterbalance on 100-ton engines. To be opened by Mr. Geo. W. West. | 12:40 P.M. | to 1:00 P.M. |
| Discussion of Individual Paper entitled "The Modern Locomotive Injector," by Mr. Strickland W. Kneass. | 1:00 P.M. | to 1:30 P.M. |

Adjournment.

CLOSING SESSION, WEDNESDAY, JUNE 20, 1906, 9:30 A. M. TO 1:30 P. M.

| | | |
|---|---|---|
| Discussion of Reports on Locomotive Lubrication. | 9:30 A.M. | to 10:00 A.M. |
| The Use of Cast Iron in Cylinders | 10:00 A.M. | to 10:30 A.M. |
| Electricity on Steam Railroads | 10:30 A.M. | to 11:00 A.M. |
| Discussion of individual papers on Best Method of Welding and Repairing Locomotive Frames without Taking Down or Removing from Engine. To be opened by Mr. R. P. C. Sanderson | 11:00 A.M. | to 11:30 A.M. |
| Fire Kindling: Cost of material, labor and time kindling fire in locomotives using either anthracite or bituminous coal. To be opened by Mr. P. Maher. | 11:30 A.M. | to 12:00 M. |
| Topical Discussions: | | |
| 1. To what extent should an engine be repaired in the main shop, and what class of repairs can be made to advantage in the roundhouse? To be opened by Mr. C. A. Seley | 12:00 M. | to 12:20 P.M. |
| 2. Relative advantage of the piston valve as compared with the slide valve. To be opened by Mr. E. A. Miller | 12:20 P.M. | to 12:40 P.M. |
| 3. Is the Walschaert valve-gear an improvement over the Stephenson link movement? To be opened by Mr. Geo. W. West | 12:40 P.M. | to 1:00 P.M. |
| Discussion of Reports on: | | |
| Subjects | 1:00 P.M. | to 1:05 P.M. |
| Correspondence and Resolutions | 1:05 P.M. | to 1:10 P.M. |
| Election of Officers. | 1:10 P.M. | to 1:30 P.M. |

Adjournment.

The Pekin & Han-Kow Railroad, 754 miles, from Pekin southward to the Yang-tze-Kiang at Han-Kow, is now in operation for its whole length, except for the bridge, nearly two miles long, over the muddy Hoang-ho. In the absence of sleeping cars, the passenger trains take three days for the journey, not running at night. French contractors are building a branch from a point about 150 miles south of Pekin on this railroad westward to Ta-yu-en, the capital of the province of Shansi, and another short railroad crosses it about 65 miles north of the Hoang-ho, extending from the river Wei, a little east of the line, westwards to anthracite mines just beyond the borders of Shangsi. The United States Steel Co. will do well to watch these branches, for, according to Baron Richthofen, who studied this country pretty thoroughly, there is another Pennsylvania in Schansi.

### Baltimore & Ohio Railroad Motive Power.

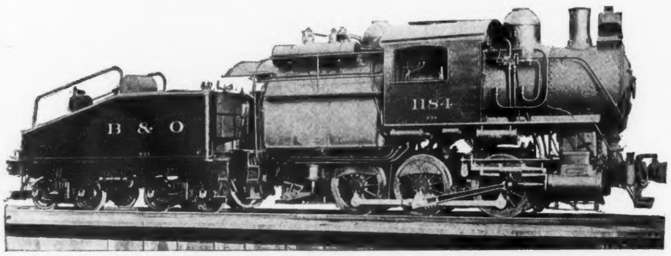
During the past three years the Baltimore & Ohio Railroad has put in service several of the most powerful designs of steam and electric freight, passenger and switching service locomotives that have been recently built.

Among these are the Mallet type mountain helper steam locomotive, the total weight, without tender, of 334,500 lbs. being distributed over twelve 56-in. diameter driving wheels, having a total flexible wheel base of 30 ft. 8 in. and a rigid wheel base of 10 ft. This locomotive has a tractive power of 74,000 lbs. in compound, and 84,000 lbs. in simple gear, with a capacity for hauling 2,200 tons in freight cars at a speed of 10 miles per hour on a 1 per cent. grade.

The new consolidation type of fast through freight steam locomotives have a total weight, without tender, of 208,500 lbs. distributed over a wheel base of 25 ft. 7 in., and a weight of 185,900 lbs. distributed over eight 60-in. diameter driving wheels, on a rigid wheel base of 16 ft. 8 in. These locomotives have a tractive power of 42,000 lbs. and a capacity to haul 1,180 tons in freight cars at a speed of 10 miles per hour on a 1 per cent. grade.

The six-wheel type of switching steam locomotives have a total weight, without tender, of 161,000 lbs. distributed over a total and rigid wheel base of 11 ft. on six 52-in. diameter driving wheels. These locomotives have a tractive power of 29,700 lbs. and a capacity to haul 720 tons in freight cars at a speed of 10 miles per hour on a 1 per cent. grade.

The two-section freight helper electric locomotives have a total weight of 320,000 lbs. distributed over a total flexible wheel base of 44 ft. 2¾ in., with a rigid wheel base of 14 ft. 6¾ in. The total weight is distributed over sixteen 42-in. diameter driving wheels, which gives these locomotives a total tractive effort, at full working load on eight motors, of 70,000 lbs. and a capacity for hauling 2,200 tons in freight cars at a speed of 10 miles per hour on a 1 per cent. grade.

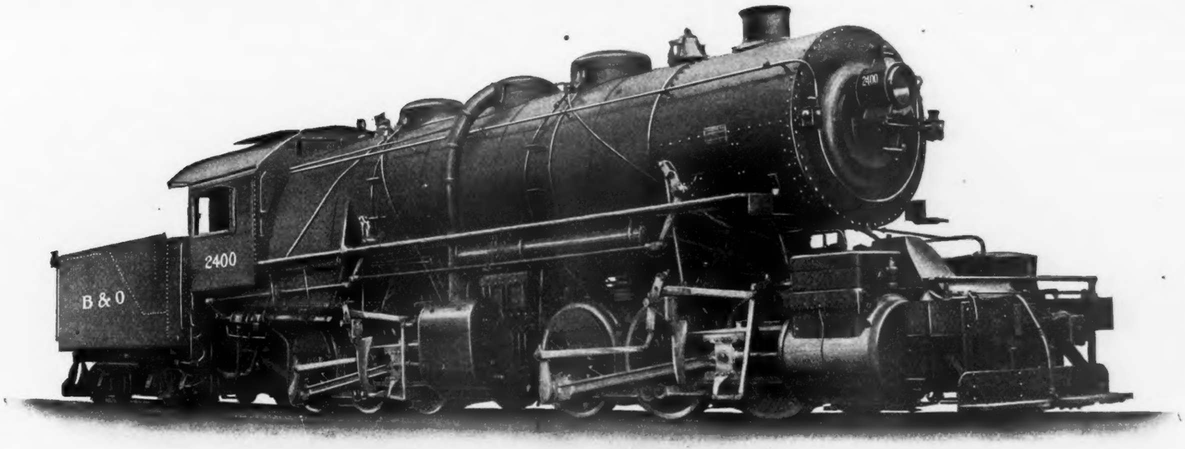



Baltimore & Ohio 6-Wheel Switcher.

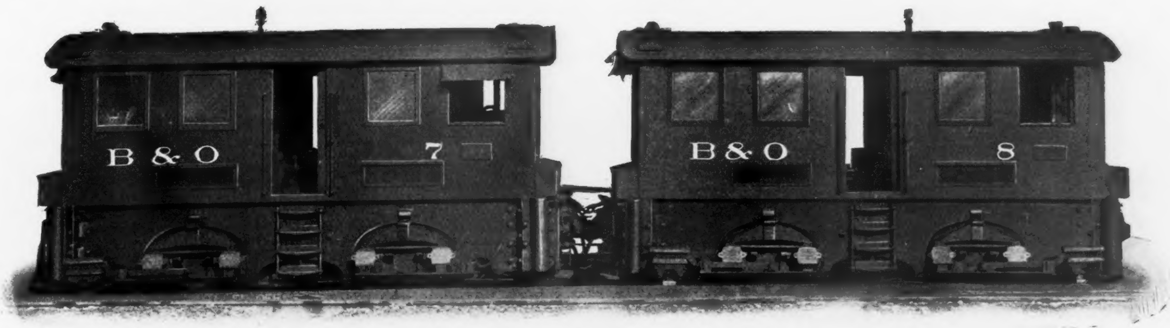
Two two-unit type of passenger helper electric locomotives, which have been in service for the past ten years, will also compare most favorably with the more recent designs of passenger electric locomotives put into service and undergoing construction for modern terminal requirements. These locomotives have a total weight of 196,000 lbs. distributed over a total flexible wheel base of 23 ft. ¾ in., with a rigid wheel base of 6 ft. 10 in. The total weight is distributed over eight 62-in. diameter driving wheels, and these locomotives have a tractive effort at full working load on four motors of 42,000 lbs., and will haul 1,500 tons in freight cars at a speed of 10 miles per hour on a 1 per cent. grade.

The most recent acquisition is a lot of 35 Pacific type passenger steam locomotives having a total weight of 229,500 lbs., without tender, distributed over a total wheel base of 34 ft. 3½ in., with 150,500 lbs. on a rigid wheel base of 13 ft. 2 in. over six 74-in. diameter driving wheels. They have a tractive power of 35,000 lbs. and a capacity to haul 970 tons in freight cars at a speed of 10 miles per hour on a 1 per cent. grade. One of the points of advanced practice in these engines to which attention should be called is the use of tubes 20 ft. long.

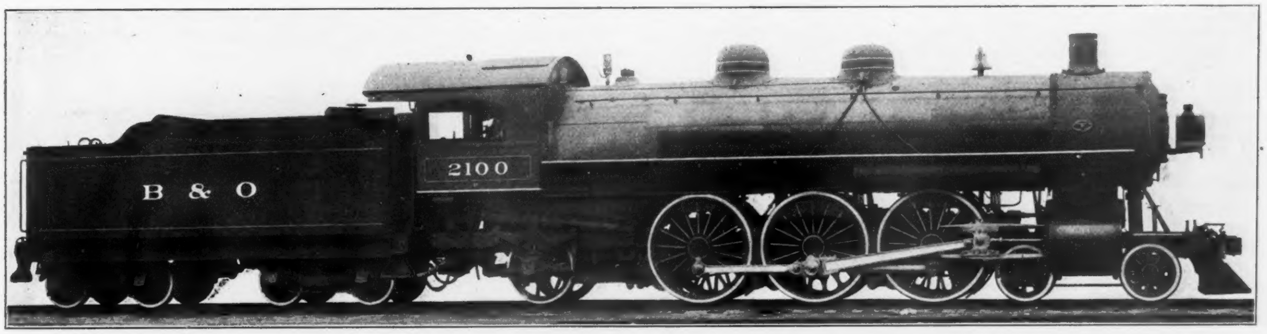
These passenger locomotives are now in regular service, and haul without a helper through passenger trains consisting of 1 baggage, 1 postal, 2 vestibule coaches, 1 dining, 3 sleeping and 1 observation parlor car, or a total of 9 cars,, approximating 425 tons, for a distance of 31.6 miles from Cumberland, Md., to Manila, Pa., near the crest of the Allegheny mountains, the total rise in altitude being 1,588 ft., in 63 minutes. This distance is made up of an average gradient of .4 per cent. between Cumberland and Hyndman, a distance of 13.9 miles, and of 1.4 per cent. between Hyndman and



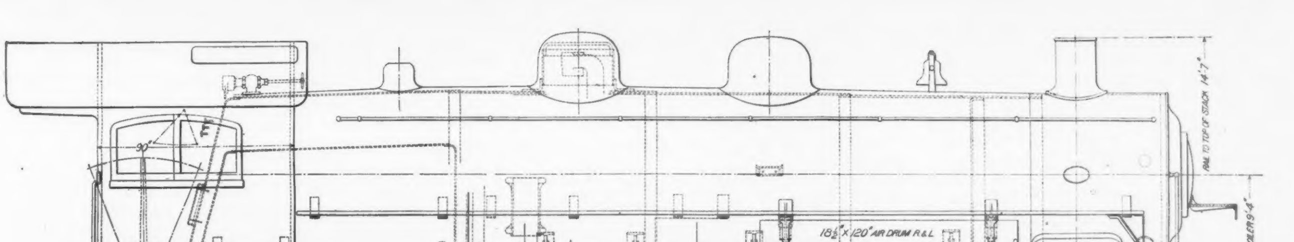

Baltimore & Ohio Mallet Compound.




Baltimore & Ohio Electric Locomotives Nos. 7 and 8.




Pacific Locomotive for the Baltimore & Ohio Designed by J. E. Muhlfeld, S. M. P., Built by the American Locomotive Co.



Pacific Locomotive for Baltimore & Ohio R. R., Built by the American Locomotive Co.

Manila, a distance of 17.6 miles. The maximum work to be done over this distance consists of 6.1 miles run on a 1.5 per cent. grade with 8 deg. curvature between Roddy and Manila, and a 1.5 mile run on a 1.93 per cent. grade.

These locomotives are also hauling passenger trains consisting of 11 cars and approximating 500 tons from a dead stop for a distance of 7 miles on a 1 per cent. grade, with from 1 to 8½ deg. curvature, in 14½ minutes.

The accompanying drawings and tabulations give an idea of the general design and proportions of these passenger locomotives, which are of the largest and most powerful type for the class now in existence. They were particularly designed for the handling of heavy through passenger trains at the required speeds over level and mountainous, open and tunneled railroad, of varying curvature and gradient.

Especial attention was given to the design of a motion gear that would provide for the quick starting and acceleration of trains, so that the schedule time could be maintained, or time made up without the use of tandem or helper locomotives on heavy grades and curvature, nor the necessity for unusually fast running on down grades.

In addition to the above, the requirements to be met by the designers in these locomotives were as follows:

The greatest proportion of adhesive to total weight of engine and tender in working order.

A substantial construction of the least number of parts.

A capacity to perform continuous service without liability for failure, and economy with respect to maintenance and fuel and water consumption.

A boiler of simple design and substantial construction, with ample grate area in one plane and firebox heating surface, together with provision for a circulation of water and unrestricted passage of gases, and suitable for the consumption of a cheap grade of either gas or soft run-of-mine bituminous coals. Especial attention was given to insure dry steam at the valve chest and cylinders by the design and location of crown sheet, steam space, throttle valve opening and surge plates.

A cylinder, frame, running and motion gears, and general design that would permit of increasing the weight and tractive power of the locomotive when the boiler tubes, tire, cab, running boards, lagging, jacketing, grates, ash pan and other similar parts require replacement, due to ordinary wear and tear, and at the same time allow

BALTIMORE & OHIO RAILROAD LOCOMOTIVES OF RECENT CONSTRUCTION.

| Class | 0-6-6-0 | 2-8-0 | 0-6-0 | 4-6-2 | 0-8-8-0 | 0-4-4-0 |
|---|---|---|---|---|---|---|
| Type | Mallet Articulated. | Consolidation. | 6-wheel. | Pacific. | 2 section 8-wh'l | 2 unit 4-wheel |
| Service | Freight. | Freight. | Switching. | Passenger. | Freight. | Passenger. |
| Motive power | Steam. | Steam. | Steam. | Steam. | Electricity. | Electricity. |
| Diagram | OOO OOO | oOOOO | OOO | oo OOO o | OOOO OOOO | OO OO |
| Kind of fuel | Bituminous coal. | Bituminous coal. | Anthracite culm. | Bituminous coal. | 625 volts, D. C. | 625 volts, D. C. |
| Weight of locomotive in lbs.: On Drivers | 334,500 | 185,900 | 161,080 | 150,500 | 320,000 | 196,000 |
| On leading truck | ......... | 22,600 | ...... | 40,500 | ...... | ...... |
| On trailing truck | ......... | ...... | ...... | 38,500 | ...... | ...... |
| Total locomotive | 334,500 | 208,500 | 161,080 | 229,500 | 320,000 | 196,000 |
| Tender loaded | 145,000 | 143,500 | 85,000 | 147,000 | ...... | ...... |
| Locomotive and tender | 479,500 | 352,000 | 246,080 | 376,500 | ...... | ...... |
| Wheels: Driving—Number and diameter over tire | (12) 56 in. | (8) 60 in. | (6) 52 in. | (6) 74 in. | (16) 42 in. | (8) 62 in. |
| Leading Truck—Number and diameter over tire | ......... | (2) 33 in. | ......... | (4) 37 in. | ......... | ......... |
| Trailing Truck—Number and diameter over tire | ......... | ......... | ......... | (2) 50 in. | ......... | ......... |
| Cylinders: Simple or compound | Compound. | Simple. | Simple. | Simple. | ......... | ......... |
| Type of compound | Mellin. | ......... | ......... | ......... | ......... | ......... |
| Diameter—High or simple | 20 in. | 22 in. | 19 in. | 22 in. | ......... | ......... |
| Diameter—Low | 32 in. | ......... | ......... | ......... | ......... | ......... |
| Stroke | 32 in. | 30 in. | 28 in. | 28 in. | ......... | ......... |
| Number of cylinders | 4 | 2 | 2 | 2 | ......... | ......... |
| Ratios: Total weight to adhesive weight | 1.00 | 1.12 | 1.00 | 1.52 | 1.00 | 1.00 |
| Weight on drivers to tractive power | 4.48 | 4.41 | 5.41 | 4.29 | 4.0 | 4.0 |
| Tractive power to heating surface | 13.3 | 15.10 | 18.03 | 10.26 | ......... | ......... |
| Heating surface to grate area | 77.5 | 49.6 | 22.5 | 60.7 | ......... | ......... |
| Tube heating surface to firebox | 24.45 | 14.57 | 8.54 | 18.02 | ......... | ......... |
| Tractive power to grate area | 1,033.0 | 749.7 | 405.5 | 622.6 | ......... | ......... |
| Cyl. volume divided by diam. of wheel to grate area | 4.97 | 6.76 | 4.16 | 5.11 | ......... | ......... |
| Hauling capacity: | | | | | | |
| Tractive Power—Comp. or simple locomotive | 74,600 | 42,168 | 29,740 | 35,020 | 70,000 | 42,000 |
| Tractive Power—At starting | 84,000 | ......... | ......... | ......... | 80,000 | 49,000 |
| Tons of loads capable of hauling at 10 m. p. h., on 1 per cent. grade | 2,200 | 1,180 | 720 | 970 | 2,200 | 1,480 |
| Firebox: Length | 108⅛ in. | 108⅛ in. | 110 in. | 108⅛ in. | ......... | ......... |
| Width | 96¼ in. | 75¼ in. | 96 in. | 75¼ in. | ......... | ......... |
| Boiler: Type | Straight top; sloping roof, sheet wide firebox. | Straight top; wide firebox. | Wooten firebox | Straight top; wide firebox. | ......... | ......... |
| Style of stays | Radial & sling. | Radial stay. | Radial. | Radial stay. | ......... | ......... |
| Working pressure, pounds | 235 | 205 | 180 | 225 | ......... | ......... |
| Diameter of barrel | 84 in. | $74^7/_{16}$ in. | 70 in. | 72 in. | ......... | ......... |
| Brick arch | ......... | ......... | ......... | ......... | ......... | ......... |
| Heating surface: Firebox | 220.0 sq.ft. | 179.4 sq.ft. | 172.84 sq. ft. | 179.4 sq. ft. | ......... | ......... |
| Tubes, water sides | 5,380.0 " | 2,612.8 " | 1,476.67 " | 3,234.6 " | ......... | ......... |
| Total | 5,600.0 " | 2,792.2 " | 1,649.5 " | 3,414.0 " | ......... | ......... |
| Water tubes | ......... | ......... | ......... | ......... | ......... | ......... |
| Tubes: Length over sheets | 21 ft. 0 in. | 15 ft. 10 in. | 11 ft. 6 in. | 20 ft. 0 in. | ......... | ......... |
| Number | 436 | 282 | 220 | 276 | ......... | ......... |
| Outside diameter | 2¼ in. | 2¼ in. | 2¼ in. | 2¼ in. | ......... | ......... |
| Grates: Area. | 72.20 sq. ft. | 56.24 sq. ft. | 73.33 sq. ft. | 56.24 sq. ft. | ......... | ......... |
| Type | Finger rocking. | Finger rocking. | Plain perforated rocking. | Finger rocking. | ......... | ......... |
| Wheel base: Driving | 10 ft. 0 in.<br>10 ft. 0 in. | 16 ft. 8 in. | 11 ft. 0 in. | 13 ft. 2 in. | 14 ft. 6¾ in.<br>14 ft. 6¾ in. | 6 ft. 10 in.<br>6 ft. 10 in. |
| Total locomotive | 30 ft. 8 in. | 25 ft. 7 in. | 11 ft. 0 in. | 34 ft. 3½ in. | 44 ft. 2¾ in. (coupled.) | 23 ft. 0¾ in. (coupled.) |
| Locomotive and tender | 64 ft. 7 in. | 59 ft. 8¼ in. | 40 ft. 9½ in. | 65 ft. 6¾ in. | ......... | ......... |
| General Dimensions: Length over all—Locomotive | 51 ft. 5½ in. | 41 ft. 3 in. | 31 ft. 4½ in. | 46 ft. 9½ in. | 58 ft. 7½ in. | 35 ft. 10 in. |
| Length over all—Locomotive and tender | 79 ft. 5½ in. | 68 ft. 7¾ in. | 55 ft. 4⅞ in. | 74 ft. 3¾ in. | ......... | ......... |
| Height, center of boiler above rail | 10 ft. 0 in. | 9 ft. 10 in. | 8 ft. 9 in. | 9 ft. 4 in. | ......... | ......... |
| Extreme height above rail | 15 ft. 0½ in. | 14 ft. 10 in. | 14 ft. 11¼ in. | 14 ft. 7 in. | 15 ft. 0 in. | 14 ft. 7½ in. |
| Gage | 4 ft. 8½ in. | 4 ft. 8½ in. | 4 ft. 8½ in. | 4 ft. 8½ in. | 4 ft. 8½ in. | 4 ft. 8½ in. |
| Valves: Type of gear | Walschaert. | Stephenson indirect. | Stephenson indirect. | Stephenson indirect. | ......... | ......... |
| Kind of valves | H.P. 10 in.; piston, L.P. Slide-d'ble ports. | Balanced; slide. | Balanced; slide. | Inside admission piston. | ......... | ......... |
| Greatest travel | 6 in. | 6 in. | $5^7/_{16}$ in. | 6 in. | ......... | ......... |
| Lap—Outside | H. P., 1⅛ in., L. P., 1 in. | 1¼ in. | ¾ in. | L—L | ......... | ......... |
| Lap—Inside | H. P., ¼ in., L. P., ¼ in. | ⅛ in. | $^1/_{32}$ in. | 1 in. | ......... | ......... |
| Lead—In full gear | H. P., ⅛ in., L. P., ⅛ in. | $^1/_{16}$ in. | $^1/_{16}$ in. | $^1/_{16}$ in. | ......... | ......... |
| Constant | Yes. | No. | No. | No. | ......... | ......... |
| Variable. | No. | Yes. | Yes. | Yes. | ......... | ......... |
| Tender: Type | Water bottom. | Water bottom. | U-sloping back. | Water bottom. | ......... | ......... |
| Capacity—Coal | 16 tons. | 15 tons. | 6 tons. | 15 tons. | ......... | ......... |
| Water (U. S. gals.) | 7,000 gals. | 7,000 gals. | 4,000 gals. | 7,000 gals. | ......... | ......... |
| H. P. at 10 m. p. h. behind tender | 2,096 | 1,124 | 686 | 924 | 2,096 | 1,410 |

for a reduction of the boiler pressure should age and general depreciation of the boiler necessitate the same without the renewal of any parts not entirely worn out or destroyed.

The same details of design, construction and material as specified for the consolidation locomotives were embodied in the Pacifics, so far as practicable, in order to insure the greatest interchangeability of parts between these and the older classes of locomotives in the stock, as could be done without the continuance of obsolete or unsatisfactory details, which would not provide for the greatest economy in maintenance and performance.

As in the case of the 210 consolidations, a sample Pacific type locomotive, No. 2,100, was constructed, in advance of the regular order, to give opportunity for a practical test and development of a design and construction to best meet the requirements, and in order to discover and correct errors, which, had they been embodied in the balance of the locomotives, would have resulted in some embarrassment from an operating and maintenance standpoint.

The above complement of steam and electric motive power now places the Baltimore & Ohio in a position to handle its constantly increasing business with despatch, reliability and economy.

## The Davis Solid Truss Brake-Beam.

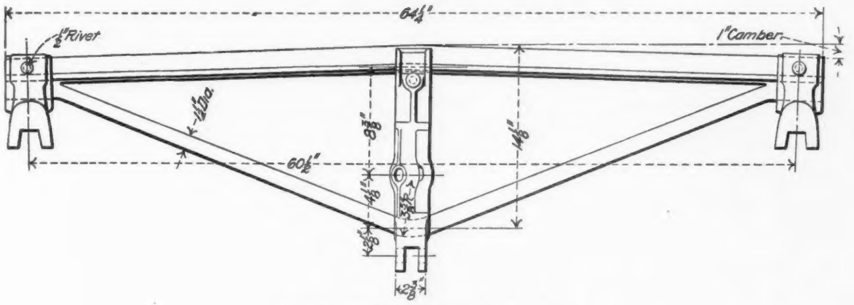
The Davis solid truss brake-beam shown in the accompanying engravings combines the advantages of the strength of a trussed beam and the solidity and simplicity of a one-piece rolled beam. The construction of other trussed brake-beams is necessarily such that after some length of service the connections of the separate members become loosened due to abrasion between the abutting surfaces of the tension and compression members, or in time break. To overcome these objections many types of rolled section brake-beams and one-piece pressed steel shapes have been designed. Such beams have a greater deflection under load per unit of weight than the truss beam and their ultimate strength is reduced. The Davis solid truss brake-beam is made in one piece, as its name implies, and has greater strength than a built up trussed beam of similar weight. The section from which the beams are made is rolled and was designed with special reference to making this particular brake-beam. It allows the maximum amount of metal in the compression member to lie nearest the tension member and at the same time provides a section in the compression member best suited to resist buckling strains. One of the illustrations shows a section of the bars as rolled.

The truss is made by a special process which consists of cutting the bulb loose from the tee section for a part of its length and leaving it uncut at each end. The tee section, which forms the compression member, is then shortened by upsetting or compressing lengthwise. This shortening causes the round section, the tension member, which has been severed from the compression member, to move outward, forming the truss rod. During the process of upsetting the compression member, the tension member, or truss rod, is not stretched or compressed, but simply bent in the center to form a seat for the strut, or brake lever fulcrum. The original length of the bar is 68 in. The compression member is upset 3¾ in., making the length of the finished truss 64¼ in. Special powerful hydraulic machinery is used throughout in making these brake-beams. The trusses are finished from the bar at one heat and are of uniform dimensions throughout.

One of the illustrations shows the struts which are used with the Davis solid truss brake-beam. They have been designed so as to place the metal where most needed. The larger, or main member, of the strut is first placed on the tension rod and the upper end forced against the compression member, thus placing the truss under its initial tension. The smaller member is then forced into place and a $^{11}/_{16}$-in. rivet is inserted hot and riveted under heavy pressure. This riveting by heavy pressure and the cooling of the hot rivet produce a tight grip.

The report of the M. C. B. Committee on brake-beams, printed elsewhere in this issue, shows the high strength and rigidity of these beams under test. In compiling the order of merit of the beams tested under direct tests, the Davis brake-beam stood first in all four of the items for beams of less than 110 lbs. weight; namely, maximum strength, minimum deflection under 7,500 lbs. load, minimum deflection under 15,000 lbs. load, and combination of the above three. The beam tested weighed 94¾ lbs. and was tested to a load of 42,000 lbs. without breaking. The deflection at 7,500 lbs. was .040 in. and the set .005 in. or .035 net. At 15,000 lbs. the beam had a deflection of .086 in. and a set of .017 or .069 net.

Mr. Nathan H. Davis, inventor and designer of the beam, is also the inventor and designer of all of the machinery used in its making. The beams are made by the Davis Pressed Steel Company, Wilmington, Del.



Davis Solid Truss Brake-Beam.


Davis Brake-Beam Struts.


Bar for Davis Solid Truss Brake-Beam and Finished Truss.


Davis Brake-Shoe Heads.

## Improved Round House Facilities.

BY J. C. STUART,
General Manager, Erie Railroad.

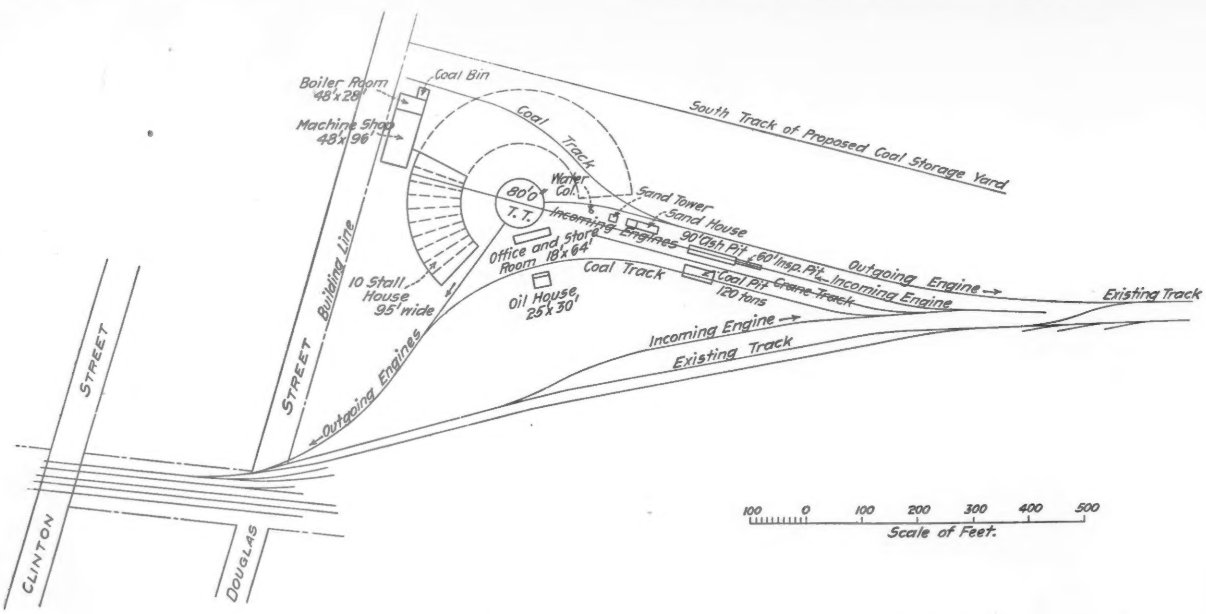
The present day large locomotive, with all the parts increased in size and weight, and therefore more difficult to handle, having a capacity of two and one-half times that of engines in service 15 years ago, carrying almost twice the amount of steam pressure and doing more than twice the amount of work, requires fully twice as much care and attention at terminals as the old locomotive did, and yet, it is evident, from an examination of the average round house and engine terminal, that there has not been the same percentage of effort expended in the development of facilities for the care of the modern large engine.

It is no uncommon sight on many railroads to-day to find men

in cinder pits shoveling cinders from the pits to the ground, and from the ground to the top of a coal car; to find a shallow cinder pit with a capacity of one engine, where the capacity, based on the number of engines handled, should be three or four. It is not uncommon to see a turntable about the same length, or six to eight inches longer than the wheel base of the engines that are obliged to use it. It is not uncommon to see round houses with engines inside so large as to render it impossible to close the doors, and it is very common to find engine houses so short that, after an engine has been put in and the doors closed, it is impossible to move material or do any work at the front end of the engine. The houses are dark, ventilation poor, badly lighted, pits heated by radiating pipes with many leaky joints, two or three inches of water in each pit from lack of proper drainage, and, at times, heated with open stoves with a stove-pipe perhaps six or eight feet long and the houses filled with gas.

Based on the importance of transportation facilities at a time when the maximum power is required, particularly in winter and when the cold weather conditions produce the greatest harm to the power and reduce its capacity

Locomotive Crane Loading Tender from Coal Cars.




10-Stall Round House and Engine Terminal at Hammond, Ind.—Erie Railroad.

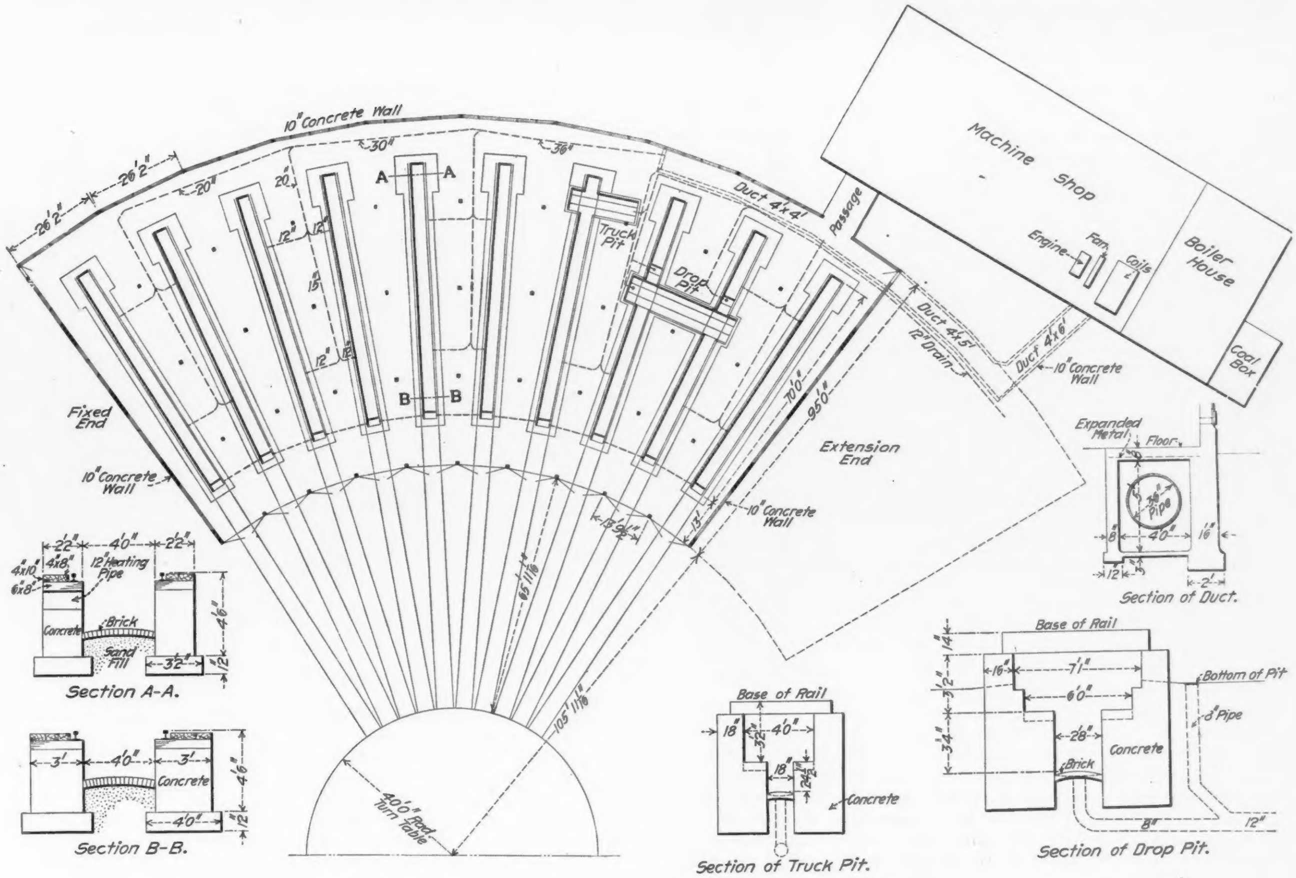
to the greatest extent, all of the possibilities just mentioned are emphasized and their detrimental effect is fully developed, with the result that, at a period when transportation is most important, yards will be filled with cars, approaching trains unable to get in yards, engines attached to them held out, no room in yards because engines cannot be made ready to take trains out, and a complete demoralization is effected by inadequate roundhouse facilities, poor methods of repairing power and an expensive organization that is not able to effect the results desired.

With all of these problems and the necessity for their improvement apparent, the Erie Railroad has adopted a standard division terminal, and, during the past year, has established 168 round house stalls, locating them in units of from 8 to 25 at various terminals.

All of the difficulties that have presented themselves in caring for and turning engines were carefully considered and an effort made to install facilities that would overcome these difficulties, and, at the same time, do it by the most economic methods.

The features of improvement that were considered in the standard round house design are illustrated in the accompanying drawings,

Locomotive Crane Loading Ashes into Cars.



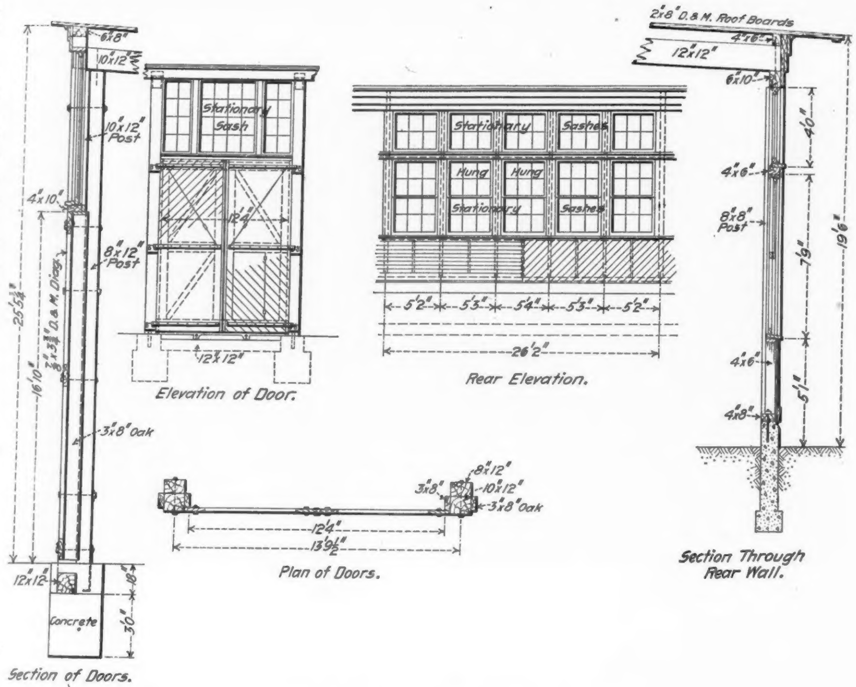

**Plan and Details of Engine House and Drop Pits.**


**Part Plan and Cross-Section of Round House.**

which show the 10-stall house recently built at Hammond, Ind. A brief explanation will be made under each heading.

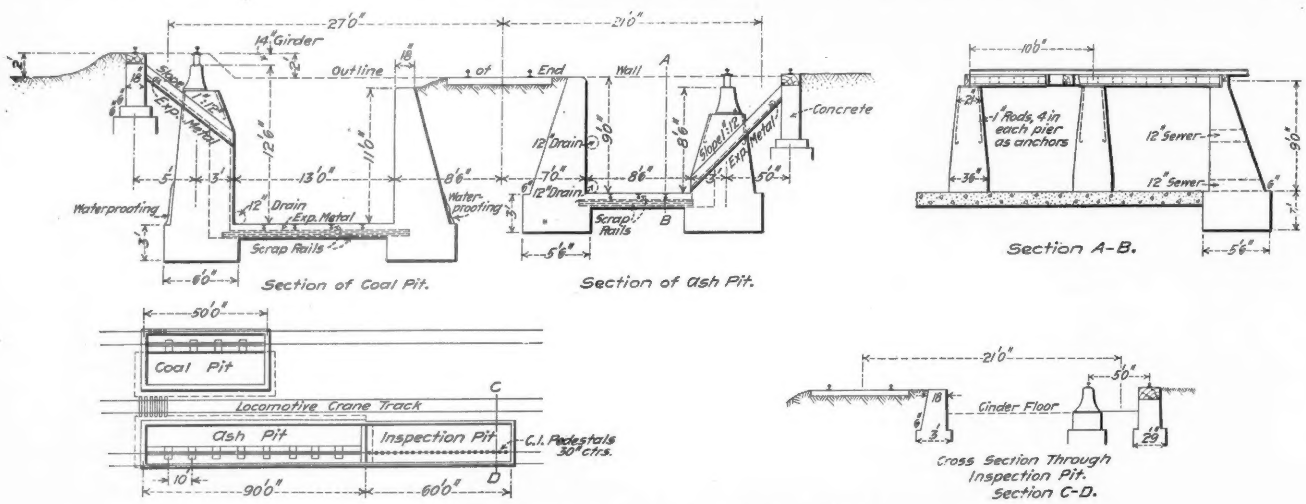
*Cinder Pit.*—The pit is built of concrete, supporting a cast iron column which, in turn, supports a box girder upon which the rail is fastened. The slope of the pit is sufficient to drop the cinders into the receiving pit. The cast iron column is intended to resist the action of the hot cinders. The pit is designed with a drainage pipe, with a valve attached which can be closed, thus retaining the water in the pit to cool cinders, and, at times, avoid unnecessary waste of water. The length of the pit is governed by the number of engines handled at each particular terminal; it can be made any length necessary. The capacity of the cinder pit is usually sufficient to carry at least two days' accumulation of cinders.

*Coal Pit.*—The coal pit is made of concrete and of very similar design to the cinder pit, with the exception of the cast iron columns, which are necessary, as the concrete can be carried up to the base of the girder. The coal pit can be made any size necessary, the controlling feature being the carrying of at least 24 hours' supply of coal, so that a night force is not required to dump coal. Its location should be about opposite the cinder pit, so that the locomotive crane, which will operate between the cinder pit and the coal pit, can perform the dual part of loading coal on engines as well as loading cinders into empty cars.




**Details of Doors and Windows in Engine House.**

*Locomotive Crane.*—A locomotive crane of 10 or 15 tons' capacity will easily care for a monthly consumption of 8,000 tons of coal and the usual amount of cinders produced by the engines that are coaled at the station. The advantage of the locomotive crane as against other mechanical appliances, or trestle work, are many. It is a machine that is simple in its maintenance and can easily be cared for by the forces employed at the round house terminal. As the machine is metal, it obviates the maintaining of a wooden

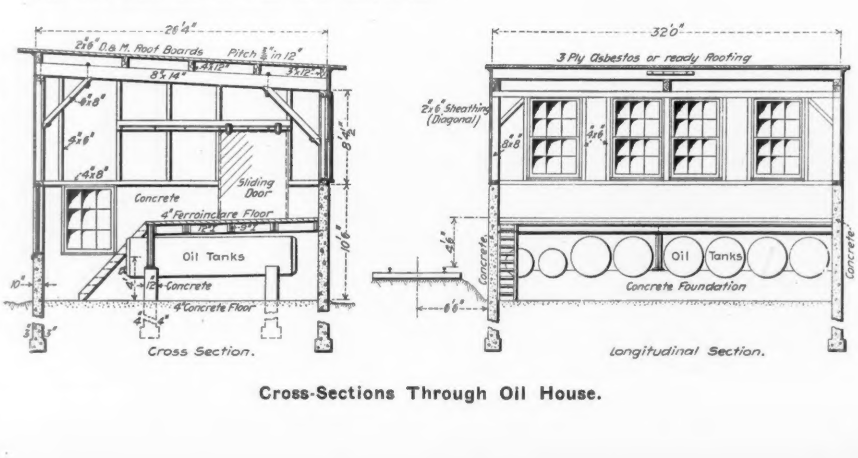



**Plan and Sections of Coal and Ash Pits.**

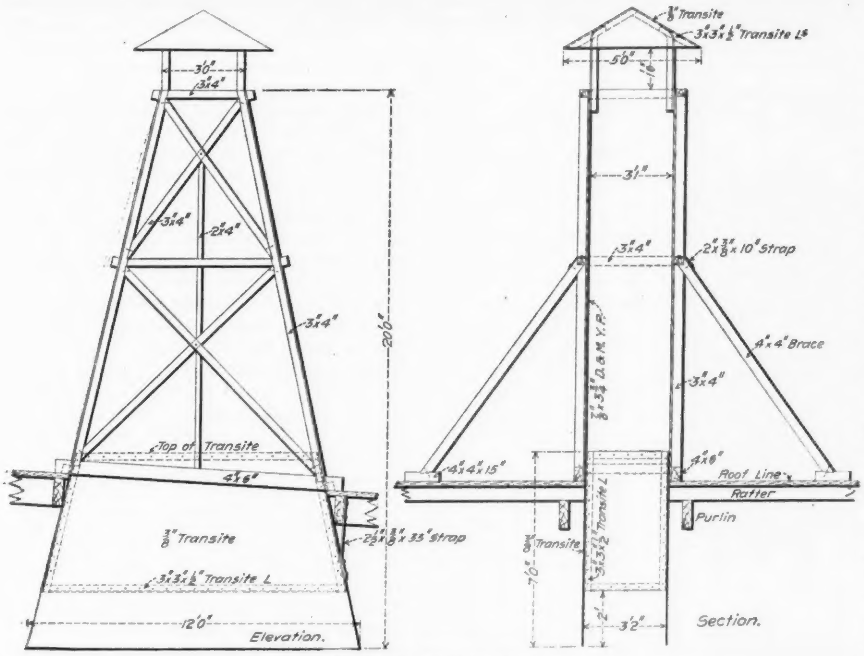
trestle, consequent repair work by carpenters and mechanics other than machine workers, the expense and danger of pushing cars up a steep grade and bringing them down again and insurance on an expensive structure that is liable to burn down. The locomotive crane is also used to unload sand from open cars through the roof of the sand house, thus eliminating any excessive labor charge for the handling of sand. It is also used to gather up refuse material which accumulates in the yard adjacent to the round house.

*Turntable.*—The standard turntable adopted is 80 ft. long. The total length from drawbar to front of pilot of the longest passenger engine in service on the Erie Railroad is 76 ft. 4 in., and it has been found by actual use that an 80-ft. turntable is of about the proper dimensions. It is quite easy to balance any type of engine regardless of the load on the tender, and it cannot be done with a table any smaller in size.

*Round House.*—In designing the round house, three important features were considered: First, the elimination of snow and ice in the inside of the circle, which so frequently obstructs the opening and closing of doors and consequently affects the temperature of the interior. Second, the elimination of girders of any descrip-




**Cross-Sections Through Oil House.**



Standard Smoke Jack.

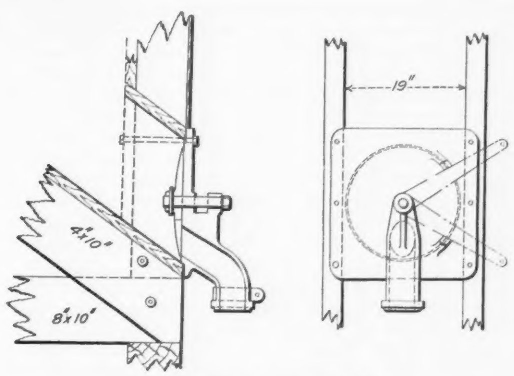
tion in the interior of the house. Third, a sufficient amount of light to permit of proper work being done on engines.

To accomplish the first aim the roof was sloped from the center to the outside, so as to carry the water away from the circle instead of towards it. All previous experiments with troughs or other devices for caring for the water, when the roof sloped towards the circle, have been found ineffective. The detail drawings show how the second and third considerations were carried out. The annoyance of leaky radiating pipes in pits, or in any portion of the round house, was eliminated by adopting the hot air system with openings leading to the pits to concentrate the heat for thawing out engines. Actual results during this last winter have demonstrated that on several occasions when the thermometer was below zero, a very comfortable temperature was maintained in round houses so equipped. Two standard drop pits were installed in each house, one for truck wheels and one for drivers. The standard length established for each round house was 95 ft. This length makes it possible to detach an engine from the tender, separate them and do work indoors in winter that otherwise could not be done without detaching the tank and moving it outside the house.

The peculiar construction of the houses—the greatest height of the roof being towards the inner circle—made it necessary to construct a very high smoke jack. This jack was made 12 ft. wide at the base, so that the smoke would be taken out of the house without making it necessary to spot an engine at any particular place. An engine can be moved a distance of 12 ft., to do work on it, and, at the same time, the gas and smoke can be carried out of the house. An additional ventilator is placed in the house which takes care of steam that might be produced from pop valves. Actual experience has demonstrated that the method of ventilation is entirely satisfactory and that houses are free from smoke and gas.

The round house pits are all of concrete, in which a small square tie is imbedded to spike the rail to; good drainage is also provided. Floors of round houses are filled with cinders to within five inches of the permanent level, then five inches of limestone screenings wetted down and rolled.

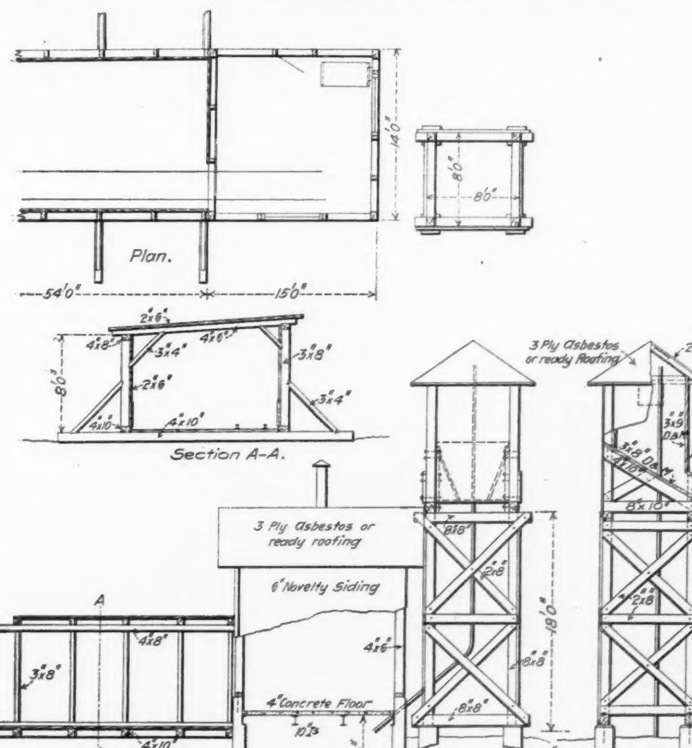
*Machine Shop.*—The standard machine shop was designed and so located as to connect directly with the round house at a central or convenient point, so that the material can be transported back and forth without undue loss of time. In each shop, a standard set of tools has been installed.


Detail of Sand Spout and Valve.

The boiler house, store house and office for the round house foreman are simple, inexpensive buildings suitable for the purposes intended.

The sand house is so located as to make it possible for the locomotive crane to unload the sand. The sand is dried and forced by air pressure to a tank and is dropped from the tank to the engines by gravity.

The foregoing cites the most important features that were considered. There are a number of other improvements that have been worked out to advantage, such as convenient locations for water cranes, steam and water pipes in round houses located overhead, injectors for washing out boilers and other details. It is believed that these round house improvements will meet more nearly the general requirements for round house terminals, particularly in bad weather, than anything heretofore in use on the Erie Railroad; and it is also believed that the liberality of dimensions will more nearly approach the increased size of locomotives now in commission, and the increased labor thereon than anything before attempted.



Longitudinal Section and Part Side Elevation.

Standard Sand House.

## Master Car Builders' Association Committee Reports.

The committee reports of the Master Car Builders' Association are, with one or two notable exceptions, quite short, this year. We have given considerable space to the excellent report on brake-beams, and have made an abstract of such of the others as are important for record.

### ARBITRATION COMMITTEE.

During the current fiscal year but 12 cases, Nos. 692-703 inclusive, have been submitted to the commission for decision. This is the smallest number of cases that have been arbitrated in many years and is a good indication that Rules of Interchange in their present shape are fairly satisfactory to the railroads of the country. As in previous years the report includes the committee's recommendations regarding proposed changes in the Rules for Interchange. The principal changes of which the committee approves or suggests the appointment of other committees to investigate are as follows: Appointment of committee to consider proposed increase in allowable variation of height of couplers. Appointment of committee to formulate combinations of defects denoting unfair usage for steel cars. Methods of splicing sills for steel and wooden cars. Increasing the price allowed for lumber from 3 cents to 3¼ cents a foot. Appointment of committee to consider additional prices for labor and material not now covered by Rule 106.

The report is signed by J. J. Hennessey, P. H. Peck, E. D. Bronner, T. W. Demarest, F. H. Clark.

### COMPOSITE DESIGN OF COUPLER.

The special committee appointed by the Master Car Builders' Association to confer with the standing committee on Tests of M. C. B. Couplers to consider the question of a composite design of coupler, held a meeting in New York City, December 11, 1905, and begs to submit the following report:

The duties of the special committee, outlined in the report of the standing committee on Tests of M. C. B. Couplers, June, 1905, read as follows:

"That the coupler committee be empowered to act in conjunction with the specially appointed committee (in which should be included representatives of the manufacturers) to early decide upon a composite design of coupler which shall contain, as far as possible, the desirable features of the best couplers as now designed, and that all patent rights involved be waived and all manufacturers be permitted to manufacture the composite coupler as adopted."

The special committee is unanimous in its opinion on this subject, and after a thorough discussion of every phase of the subject that could be thought of it was decided that the instructions could not be carried out and were impracticable at this time.

It developed that of all the couplers currently bought and used in the United States to-day probably 90 per cent. were made by manufacturers who were represented on the committee.

It was agreed that only three or four of the couplers made (all of which were represented on said committee) complied reasonably well with the Interstate Commerce Safety Appliance Act; that none of the manufacturers were willing to give up their patent rights and surrender them to the association. The reasons given by their side were principally two-fold:

First, That we were asking them to surrender a considerable and valuable portion of their stock in trade, whereby they control the manufacture of the couplers for their own benefit.

Second, That if the manufacture of couplers were thrown open to any steel foundry or any malleable iron foundry there would be no possible way in which the manufacture of inferior couplers, by any and every manufacturer, to the detriment of the standard manufacturers, could be prevented, the presence of which in the cars of the country would entail great cost on the railroads, and be unfair to those who wished to purchase an efficient coupler complying with the specifications.

It was the consensus of opinion of the railroad representatives that it would be entirely unfair and not in accordance with business ethics to ask the manufacturers to surrender their rights without compensation, and that the Master Car Builders' Association is not a body which can properly acquire rights of this character and sell them or give them to manufacturers, without rendering itself liable to charges of unfair discrimination.

And further, that the adoption of such a standard as was proposed by the instructions would stop and impede progress in the coupler business, unless this work were undertaken by the association, through the agency of the standing committee at the expense of the association; whereas now all reputable manufacturers spend considerable money yearly in developing and perfecting the couplers presented to railroad companies, thus meeting the increased demands of service without cost to the user.

It was agreed that it was a probable impossibility that any coupler could be designed which did not embody infringements on existing valid patents.

As the instruction required that the principal and best features of existing couplers shall be embodied in the design the committee was to work out, the position taken by the manufacturers blocked any possible action that could be taken by the committee.

As it seemed that the principal reason for the appointment of this committee was the trouble experienced by railroad companies to-day in keeping a stock of, and making repairs to, the very large number of patterns of couplers, and that this was the principal and real reason for the desired action, and as it was agreed that the existing couplers of many patterns could not be arbitrarily expunged from the cars, but would have to wear themselves out, it would be impossible, even if a standard coupler could be adopted to-day, to do more than gradually reduce the many patterns of couplers now in existence.

It was admitted and agreed that if we only had three or four kinds of couplers there would be no cause for complaint under this heading, and that other action would not be needed.

As it was shown, that for the reasons first mentioned the purchase of couplers had practically narrowed itself down to three or four makes, in this country, and the elimination of the many different patterns of couplers was already in progress, and that as the old couplers disappeared, renewals all being made by couplers of three or four makes, the principal source of annoyance now existing would be eliminated.

It was agreed that the second recommendation of the standing committee on Tests of M. C. B. Couplers, in its report to the M. C. B. Association in June, 1905, which was "That the present policy of the association be followed out; that is, that the gradual improvement of the M. C. B. standard coupler and the elimination of poorly designed and weak couplers be carried on as at present by making the requirements to be met by the M. C. B. coupler more and more rigid, thus compelling a higher degree of efficiency, and closely prescribing the limits for the future within which designers may work, while at the same time in no way preventing beneficial competition" —and which recommendation was not acted on by the convention—is far the best, and, in fact, the only plan which the association can follow; that is, to have standard requirements for couplers and narrow these requirements down so as to limit the number of couplers which can successfully fulfil such requirements, and in this way drive out of the field inferior makes and multiplicity of patterns, leaving the field open for reasonable and honorable competition and development.

This committee strongly recommends that in the future no couplers be purchased by railroad companies unless they meet the requirements of the Master Car Builders' Association and the recommendation of the standing committee on Tests of M. C. B. Couplers, as in this way the elimination of all couplers which do not fulfil the requirements would soon be effected.

The report is signed by F. W. Brazier, R. P. C. Sanderson, A. Stewart, T. S. Lloyd, C. E. Fuller, J. T. Chamberlain, for the M. C. B. Association, and H. C. Buhoup, the Janney Coupler Co.; Samuel Lewis Smith, Nat'l Mall. Castings Co.; S. P. Bush, Buckeye Steel Castings Co.; W. L. Jacoby, Latrobe Steel Coupler Co.; F. P. Huntley, Gould Coupler Co., for the coupler manufacturers.

### AUTOMATIC CONNECTORS.

This committee was appointed to prepare standard dimensions for automatic couplings for steam heat, air brake and air signal, also to fix the relative locations and dimensions of the different parts so that as cars are equipped from time to time with such automatic couplings, the various makes will be interchangeable, one with another.

It is recommended that these devices be called connectors, instead of couplings, so that they may be distinguished the more readily from the drawbar device. This report will refer to them as automatic connectors.

Of the automatic connectors now in use, there are two general types, the important difference and the one which must be reconciled before the instructions to the committee can be carried out is the line on which two engaging connectors are parted. In the one type the parting is on a line at right angles to the center line of track; these make a butt joint and may be refered to as butting connectors. The other type is parted on a line parallel with the center line of track; this may be referred to as the lapping connector. It would be impossible to couple one type directly to the other.

The lapping type is made by one company and in their opinion their patents would prevent others from making a connector similarly parted. The butting connector is made by at least four companies and the interchangeability of the four butting connectors can be readily accomplished. There are some of both types in service.

The committee thinks that under the circumstances it is not warranted in recommending either type as standard, but because of the patent situation it favors the butting connector. If these views meet with the approval of the association it is recommended that

the present committee be continued, or a new committee be appointed and requested to follow out, with respect to the butting connector, the instructions quoted in the first paragraph of this report.

The committee recommends further that the railroads discourage the use of automatic connectors until the manufacturers make arrangements by which any company may make a connector which will couple with the connector made by any other company.

The report is signed by F. M. Whyte, C. E. Fuller, F. H. Clark, George W. Smith.

### AXLE LIMITS.

In its report to the convention of 1905, the Arbitration Committee, in connection with Rule 23 of the Rules of Interchange, refers to a suggestion made by two of the railroad clubs and by two railroad officers, in regard to the replacing of axles under foreign cars on account of defective wheels or axle, and providing that axles should be not less than the limits stated in the recommendations, and proposing that, instead of basing the limiting diameters of axles on the capacity of cars, they should be based upon the light weight added to the capacity and plus 10 per cent. of the capacity, calling the total weight on the rails thus obtained the maximum weight.

COMPARISON OF AXLE DIAMETERS.

| Nominal Capacity | Axle. | Load for Axles in Pounds. | Limiting Diameters. Journal. Rule 23. | Journal. Proposed | Wheel Seat. Rule 23. | Wheel Seat. Proposed. | Center. Rule 23. | Center. Proposed. |
|---|---|---|---|---|---|---|---|---|
| 100,000.......... | D | 38,000 | 5" | 5" | 6¾" | 6¾" | 5⅞" | 5⅞" |
| 80,000.......... | C | 31,000 | 4½" | 4½" | 6¼" | 6¼" | $5\frac{5}{16}$" | 5⅜" |
| 70,000.......... | C | 26,000 | 4" | 4¼" | 5⅝" | 6" | 4⅞" | 5¼" |
| 60,000.......... | B | 22,000 | 3¾" | 3¾" | 5" | 5½" | 4⅜" | 4¾" |
| 50,000.......... | B | 18,000 | 3½" | 3½" | 4¾" | 5¼" | 4⅛" | 4⅝" |
| 40,000.......... | A | 15,000 | 3¼" | 3¼" | 4⅝" | 4⅞" | 3⅞" | 4¼" |
| 30,000.......... | A | 13,000 | 3" | 3" | 4¼" | 4¾" | 3½" | 4⅛" |
| 20,000.......... | A | 10,000 | 2¾" | 2¾" | 4¼" | 4¼" | 3½" | 3¾" |

LIMITS FOR AXLES BASED ON MAXIMUM WEIGHT OF CAR.

| Nom. Cap. of Car. Lbs. | Axle. Designation. | Axle. Load. Lbs. | Weight of Axle and Wheels. | Permissible Weights per Axle at Rail. | Permissible Weights of Car and Lading at Rail. | Proposed Maximum Weight of Car and Lading at Rail. | Limiting Dimensions. Journal. Calculated. | Journal. Proposed. | Wheel Seat. Calculated. | Wheel Seat. Proposed. | Center. Calculated. | Center. Proposed. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100,000 | D | 38,000 | 2,200 | 40,200 | 160,800 | 161,000 | 4.75 | 5 | 6.70 | 6¾ | 5.73 | 5⅞ |
| 80,000 | C | 31,000 | 1,925 | 32,925 | 131,700 | 132,000 | 4.32 | 4½ | 6.21 | 6¼ | 5.32 | 5⅜ |
| 70,000 | C | 26,000 | 1,925 | 27,925 | 111,700 | 112,000 | 4.15 | 4¼ | 5.89 | 6 | 5.03 | 5¼ |
| 60,000 | B | 22,000 | 1,675 | 23,675 | 94,700 | 95,000 | 3.71 | 3¾ | 5.48 | 5½ | 4.67 | 4¾ |
| 50,000 | B | 18,000 | 1,675 | 19,675 | 78,700 | 79,000 | 3.43 | 3½ | 5.22 | 5¼ | 4.51 | 4⅝ |
| 40,000 | A | 15,000 | 1,450 | 16,450 | 65,800 | 66,000 | 3.10 | 3¼ | 4.80 | 4⅞ | 4.09 | 4¼ |
| 30,000 | A | 13,000 | 1,450 | 14,450 | 57,800 | 58,000 | 2.97 | 3 | 4.58 | 4¾ | 3.90 | 4⅛ |
| 20,000 | A | 10,000 | 1,450 | 11,450 | 45,800 | 46,000 | 2.72 | 2¾ | 4.19 | 4¼ | 3.57 | 3¾ |

The limits for axle diameters given in Rule 23 should be understood as interchange limits. Modifications in these limits have been discussed at various times, but it must be remembered that the substitution of M. C. B. standard axles for those of older designs necessarily takes time, and the committee is satisfied, from information which it has obtained, that if the present limits in Rule 23 were increased at this time it would bring serious hardship upon a number of railroads and result in the stopping, at interchange points, of cars that still have axles of the older designs.

It would, therefore, seem unwise, at this time, in view of the fact that there is no serious difficulty in moving cars under the present limits, to change them, especially in view of the general effort being made to substitute the M. C. B. standard axles for those of the older designs, as far as operating conditions will permit. The committee, however, cannot refrain from urging all members of the association to continue their efforts in this direction, in order that axles of the earlier design may be eliminated at the earliest practical date.

There seems to be good reason, however, why the general suggestion made to the Arbitration Committee, in 1905, should be the subject of discussion and recommendation.

The load carried on the axles is made up of the light weight of the car and the weight of the lading, from which would properly be deducted the weight of wheels and axles, as the weight of these is not transmitted to the journals. The standard axles are designed to carry stated loads, and not for cars of stated capacity. A comparatively light car body carried by axles of designated size is entitled to a larger weight of lading when the capacity of a car is made the basis of axle diameters, regardless of the weight of the body, comparatively light cars are not carrying as much lading as they should; and, further, that axles are, in some cases, overloaded where the car body is excessive in weight and the marked capacity is not reduced accordingly.

The committee, therefore, proposes that the present method of marking cars be changed and that all cars ultimately should be stenciled with light weight and maximum weight. The former is, of course, the present light weight as used on all cars. The latter is the limiting weight that should be carried on four axles, depending, of course, on their diameters. It is not thought that shippers or others will be seriously inconvenienced by this change, and, on the contrary, the benefits to the railroads will be considerable.

The table entitled "Limits of Axles Based on Maximum Weight of Car" shows the present nominal capacity, the designation of each of the M. C. B. standard axles, and the load each was designed for. To this latter weight may be added the weight of wheels and axle, in order to arrive at the permissible weight per axle at the rail, as given in the fifth column. This permissible weight multiplied by 4 gives the total permissible weight at the rail for a car with four axles, and column 7 gives, in round numbers, the proposed maximum weight as recommended by your committee.

The table entitled "Comparison of Axle Diameters" shows the proposed limits as compared with those of Rule 23. It will be noted that for cars of nominal capacity of 100,000 pounds and 80,000 pounds, the only change is in the center of axle "C," which should be increased $^1/_{16}$ of an inch. For 70,000-lb capacity cars it is proposed to increase the limits for all diameters of the axle. For cars of 60,000, 50,000, 40,000 and 30,000 lbs. capacity, the limiting diameter for wheel seat and center would have to be increased. For cars of 20,000 lbs. capacity the limiting diameter of center only should be increased.

It should be understood, in the plan proposed, that the limiting diameters as now given in Rule 23 would hold good for all cars having capacity marks, but that where the marking on cars is changed to show light weight and maximum weight the proposed limits, as shown in the table mentioned, would hold good. It is naturally assumed that cars having the older designs of axles will continue to have capacity marks up to the time when the axles under them may be changed to the standard axles, at which time the capacity marks would be removed and the maximum weight substituted.

Assuming that the plan above described meets with the approval of the association, it would appear necessary to make modifications in both Rules 23 and 74, and the recommendation of the committee is that they should be changed to read as follows:

"Rule 74. When second-hand axles are applied under conditions which make them chargeable to the owners, the diameters of the wheel seats and center must not be less than, and the diametr of tne journal must be ⅛ inch greater than the limiting diameters given in Rule 23. If cars are marked with the word 'Capacity,' the first set of limits must be followed. If cars are marked 'Maximum Weight,' the second set of limits must be followed."

"Rule 23. Axles less than the following prescribed limits:

| *For Cars Marked with "Capacity."* Capacity of car. | Journal. | Wheel seat. | Center. | *For Cars Marked "Maximum Weight."* Maximum weight. | Journal. | Wheel seat. | Center. |
|---|---|---|---|---|---|---|---|
| 100,000 | 5 in. | 6¾ in. | 5⅞ in. | 161,000 | 5 in. | 6¾ in. | 5⅞ in. |
| 80,000 | 4½ " | 6¼ " | $5^5/_{16}$ " | 132,000 | 4½ " | 6¼ " | 5⅜ " |
| 70,000 | 4 " | 5⅝ " | 4⅞ " | 112,000 | 4¼ " | 6 " | 5¼ " |
| 60,000 | 3¾ " | 5 " | 4⅜ " | 95,000 | 3¾ " | 5½ " | 4¾ " |
| 50,000 | 3½ " | 4¾ " | 4⅛ " | 79,000 | 3½ " | 5¼ " | 4⅝ " |
| 40,000 | 3¼ " | 4⅝ " | 3⅞ " | 66,000 | 3¼ " | 4⅞ " | 4¼ " |
| 30,000 | 3 " | 4¼ " | 3½ " | 58,000 | 3 " | 4¾ " | 4⅛ " |
| 20,000 | 2¾ " | 4¼ " | 3½ " | 46,000 | 2¾ " | 4¼ " | 3¾ " |

"All cars to have their light weight and capacity or their light weight and maximum weight stenciled on them."

The report is signed by E. D. Nelson, J. H. Manning, C. D. Pettis.

### HIGH SPEED BRAKES.

The committee, appointed to look into the question recommended practice for high-speed, foundation brake gear for passenger equipment cars, finds that the gear for four-wheel trucks is satisfactory. There are some small changes in the gear for six-wheel trucks which should be made before it is passed to M. C. B. Standard. The objects to be accomplished by these changes are: Means for taking up by hand the slack, which accumulates from brake shoe and tire wear, more quickly and in smaller increments than is now possible. The committee has in service an arrangement for accomplishing these results, but the information so far collected is not sufficient to warrant making definite recommendations covering the six-wheel truck. The committee asks for another year in which to complete its investigations.

The report is signed by F. M. Gilbert, C. B. Young, M. Dunn, J. J. Hennessey.

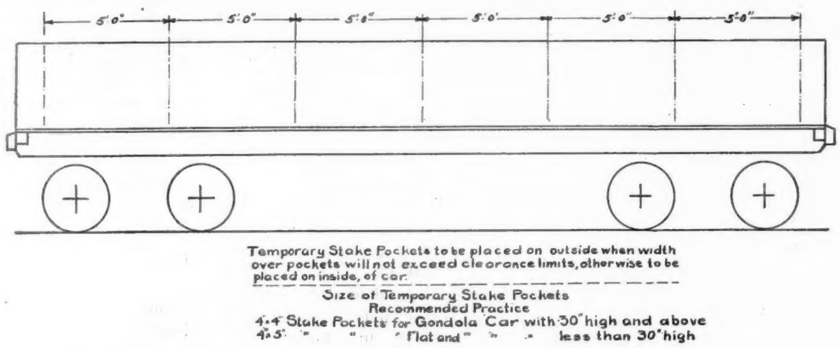
### LOCATION OF TEMPORARY STAKE POCKETS.

The committee, having been instructed to investigate and report on a standard location for temporary stake pockets, made many

inquiries, but with little success or encouragement. This question was mentioned last year in connection with the size of temporary stake pockets, then under discussion. The size for the pocket was quickly disposed of by a motion made to the effect that a 4 by 5-in. pocket for flat cars and gondola cars with sides less than 30 in. high, and a 4 by 4-in. pocket for gondola cars with sides 30 in. high or over, be considered a recommended practice. This question was put to letter ballot and adopted.

The establishment of a uniform location for temporary ballot stake pockets grew out of a suggestion on the part of the pipe manufacturers, they alluding to the apparent wisdom of uniformly spacing the pockets if practicable, so as to accommodate at least the more common or stock lengths; and this also seemed reasonable from the standpoint of the lumbermen.

Ordinarily the temporary stake pockets are spaced uniformly between the permanent stakes, their distance from center to center varying but little from the dimensions indicated on cut shown herewith. Again, the temporary stake pockets are spaced midway between alternate permanent stakes, while others are located without apparent reference to the position of the permanent stakes; the distance between centers being as much as 7 ft. 4¼ in., and perhaps higher. This, of course, is considerably in excess of what would give us three stakes for material 18 ft. long, which is one of the requirements of the rules for loading long material. The same may also be said of the pockets placed on the inside of steel cars, there being no apparent uniformity in their location. This, no doubt, has been done by the car owners upon the assumption that such spacing is quite sufficient for the traffic they expect to handle.




**Longitudinal Spacing for Temporary Side Stake Pockets on Gondola Cars.**

The committee did not hope to be able to recommend a standard location for temporary stake pockets or even a location for a recommended practice; but, through the kindness of some of the pipe manufacturers who have manifested a particular interest in this work, have been able to secure a suggestion that would seem to at least satisfy that class of traffic, and incidentally would accommodate lumber shipments except loads handled on twin and triple cars, where it is required they be spaced, from center to center, not less than 2 ft. nor more than 3 ft. 6 in., as referred to in Rule 48 (Rules for Loading Long Materials). The latter, however, is somewhat special and refers to a shipment usually handled on flat cars where the stake pockets are but seldom in excess of that measurement.

The cut herewith shows the longitudinal spacing for temporary side stake pockets, which, as above mentioned, would seem to conveniently accommodate the general run of short lumber and pipe shipments handled in gondola cars.

The report is signed by A. Kearney, C. E. Fuller, A. Stewart, F. H. Clark, T. H. Curtis, J. S. Lentz, W. F. Keisel, Jr., L. H. Turner.

### TANK CARS.

The Executive Committee on February 12, 1906, reappointed the former committee on Tank Cars, with a request that revised specifications be submitted for consideration as Recommended Practice. The necessity for this has already been brought to the attention of railroads which have issued circulars on the subject of tank car interchange, and the recommendations hereinafter submitted are taken almost bodily from one of the railroad circulars, which circular was issued after joint conference of a number of roads issuing similar circulars, namely:

*Requirements for Tank Cars.*

Tank cars offered for movement over the lines of this company must conform to the following general and detail specifications:

*General Specifications.*

Tank cars which bear evidence of damage from fire must be withdrawn from transportation service.

Each truck must have a strength equal to or greater than the strength of the axles used. Table following specifies the maximum weight of loaded car which can be used with various designs of axles:

| Minimum — Journal diameter, | Minimum — Diameter of wheel fit. | Diameter at center. | Maximum weight of loaded car. |
|---|---|---|---|
| 3¼ in. | 4⅝ in. | 3⅞ in. | 66,000 lbs. |
| 3½ " | 4¾ " | 4⅛ " | 76,000 " |
| 3¾ " | 5 " | 4⅜ " | 96,000 " |
| 4 " | 5⅝ " | 4⅞ " | 106,000 " |
| 4½ " | 6¼ " | 5⁵⁄₁₆ " | 132,000 " |
| 5 " | 6¾ " | 5⅞ " | 161,000 " |

(NOTE.—The above rating for axles is based on maximum weight of loaded car, because of the wide variation in specific gravity of loads carried and on account of the impossibility of determining the weight of the load by inspection. The dimensions correspond with the present Interchange Rules. In case of a modification of the Interchange Rules to include maximum weight of loaded car as a basis for axle limits, such rules should supersede the axle requirements here given.)

Each car must be equipped with air brakes of a capacity equal to 70 per cent. of the light weight of car, and at least one hand brake operating brakes on both trucks.

Each end of car must be provided with the necessary steps, grab irons, etc., to comply with the requirements of the M. C. B. Association. Each tank car must be provided with adequate side hand railing. This may be either as shown on Sheet No. 19 of the M. C. B. Association, or by adequately securing it to the tank itself, but must be so placed as to be readily within reach of trainmen. Where from the construction of a car, a side hand railing is inadmissible, the construction involving an overhead running board and high brake staff, each end of car must be provided with such ladders as will comply with the requirements of the M. C. B. Association.

After September 1, 1906, there shall be a push-pole pocket at each corner of the car. Where from the construction of the car, the push-pole pockets cannot well be placed on the body, they may be applied to the trucks, placed above the end journal boxes.

Tanks must be secured from turning on the underframes, either by center anchors riveted to the tank and underframe, or by means of dome yokes, and must also be secured to underframe by means of tank straps, two for tanks not more than 76 in. in diameter, and four for tanks of greater diameter. The sectional area of dome yokes and tank bands must at no place be less than ¾ sq. in. Cars having no underframe, with tanks securely riveted to body bolsters, do not require dome yokes or tank bands.

Tanks must be carefully inspected and tested with cold water pressure at least once in five years. The test for new tanks should be at 60 lbs. per sq. in., and for old tanks at 40 lbs. per sq. in., which they must stand without serious leak or evidence of distress. This inspection and test must be made by the tank car owners, and all tanks must be so tested by January 1, 1908. Tanks, when tested, must be stenciled with date and place where test was made, and by whom, as follows:

Tested (Date) ..........................................
Pressure (pounds per square inch) ......................
At (Place) .............................................
By (Name of firm) ......................................

New steel or iron tanks must be designed for a bursting pressure of not less than 240 lbs. per sq. in.

*Application of Safety Valves.*

All tanks carrying volatile or inflammable material, such as crude petroleum, fuel oil, benzine, naphtha, kerosene, illuminating oils, petroleum products, turpentine, etc., must be equipped with 5-in. safety valves of the recommended design; one valve for a capacity of 6,500 gallons or less, and two valves for a capacity of more than 6,500 gallons. Where tank cars carrying such products are subdivided into compartments, each compartment must be provided with a safety valve. Where only one valve is used, it must be set to open at a pressure of 8 lbs. per sq. in.; where two valves are used, only one must be set to open at a pressure of 8 lbs. per sq. in., and the other at 12 lbs. per sq. in.

Tank cars carrying volatile, non-inflammable products, such as gas liquor, ammonia liquor, etc., where the prevention of evaporation is essential, may be provided with vents depending on frangible lead discs for safety, which vents shall be of recommended design, the discs to be of a thickness that shall insure rupture at pressure not higher than 25 lbs. per sq. in.

In the case of coal tar, where from the nature of the product absolute tightness is desired, either the frangible lead disc or the 5-in. safety valve will be accepted, or, if the shippers so elect, an open vent may be used.

Tank cars carrying non-inflammable or non-volatile material,

such as sulphuric acid, vinegar, linseed oil, cottonseed oil, lard oil, fish oil, tannery products, glucose, molasses, calcium chloride, caustic soda, silicate of soda, etc., need not be provided with 5-in. safety-valves, but each tank should have a small open vent or valve.

*Old Tank Cars Having Wooden Underframes.*

Tank cars having wooden underframes, of railroad, foreign or individual ownership, will be required to conform to the foregoing general specifications, and, in addition, must be as strong as the construction covered by the following detailed specifications:

If cars are not equipped with intermediate sills, the underframes must have two center sills, each not less than 5 in. wide by 10 in. deep, spaced not more than 18 in. apart. If the car is equipped with intermediate sills, the center sills should not be less than 5 in. wide by 9 in. deep.

Where draft timbers are underneath the center sills, the space between the center sills must be filled in with timbers not less in depth than center sills, extending from end sill to center of nearest cross-bearer or cross-timber, provided the latter is located not less than 4 ft. 6 in. from center of bolster. Center sills and filling timbers must be securely bolted together by means of ¾-in. bolts. On cars having center or intermediate sills not less than 10 in. wide by 10 in. deep, the filling timbers may be omitted.

End sills must not be less than 9 in. wide by 10 in. deep. End sills 6 in. wide by 12 in. deep, reinforced with buffer blocks not less than 6 in. wide by 10 in. deep and of sufficient length to overlap center sills, will be accepted as a substitute for the 9 by 10-in. end sills.

Draft timbers secured to inside of center sills and extending to cross-bearer or cross-timber, will be accepted as a substitute for filling timbers referred to above. Where center sills are 9 in. wide by 10 in. deep in section or over, and draft timbers are placed between same, they need not extend farther back than body bolster, provided they are adequately secured to center sills by means of seven ⅞-in. bolts or their equivalent, and butt against body bolster. Draft timbers located underneath the center sills must not be less than 4 in. wide by 8 in. deep, and each draft timber must be held to end sills and center sill by means of seven or more ⅞-in. bolts. Draft timbers extending beyond bolster must be secured to center sills by additional bolts.

The draft gear and draft attachments must be at least as strong as the recommended design. (Not shown.)

In all cases, tail yokes must be used; and tail bolts, tail straps or American continuous draft gear will not be accepted. Tail yokes as per M. C. B. standard, or attachments of equal strength, are acceptable.

Head blocks must not be less than 10 in. wide, unless reinforced by metal plates, and of sufficient depth to extend at least 6 in. above bottom of tank and may be made of two pieces bolted together and bolted to underframe by means of not less than four ⅞-in. vertical bolts. Head blocks must be cut out to suit curve of tank and, preferably, be supported at center by means of substantial casting securely bolted to end and center sills. Where the construction does not permit of this casting, then head blocks secured by stay-rods 1⅜ in. in diameter anchored to center sills, will be accepted. Where stay-rods are but 1 in. in diameter the ends of head block must be tied to corresponding ends of head block at the other end of car by means of two rods not less than 1 in. in diameter with 1⅛-in. threaded ends, or two 1-in. rods passing diagonally through head blocks towards bolster and secured to underframe, or straps not less than ¾ in. thick and 3 in. wide, passing over head blocks and securely fastened to underframe, will be accepted.

Where tank cars are fitted with cast-iron dome heads and covers not sufficiently strong to stand the necessary 40 lbs. hydraulic test, they may be replaced by others of pressed steel or of malleable iron.

Tank heads less than $^7/_{16}$ in. thick, bearing evidence of damage from impact with head blocks, should be reinforced at bottom by means of steel plate shoes ⅜ in. thick, riveted to head and shell.

*New Tank Cars.*

All tank cars built hereafter must be equipped with steel underframing or with reinforced shell. The design must be at least as strong as that shown in cut H on page 323 of the 1903 M. C. B. Proceedings.

New tank cars must conform to the general specifications given in the foregoing, in addition to the following detail specifications:

The center sill construction of the underframe, between bolsters, must have a sectional area of at least 30 sq. in.

Each car must be equipped with steel body and truck bolsters, steel couplers and a draft gear (preferably of the friction type) of approved design, having a capacity of at least 60,000 lbs. Tail bolts or straps must not be used.

All longitudinal and head seams must be double riveted. Where head blocks are not used, head seams need not be double riveted.

The construction of the car throughout must be at least as strong as the recommended design. (Not shown.)

If the car has no underframe, the tank shell at bottom must be at least ⅝ in. thick, and all circumferential seams must be double riveted. The sectional area of the additional metal in bottom of tank shell must be at least 20 sq. in.

Particular attention must be given to the longitudinal anchorage of the tank, which must be thoroughly substantial, to prevent end shifting.

Dome heads and covers must be made of either cast or pressed steel or of malleable iron.

With the view of complying with the above-mentioned construction, the Pennsylvania Railroad Company has had patented the design shown in cut H on page 323 of the 1903 M. C. B. Proceedings and then assigned to the P. R. R. Company. The opinion of the Eastern Railroad Association on the design in question was ascertained in order to see whether such car could be constructed anywhere without liability of patent infringement. The Pennsylvania Railroad has therefore thrown open to the public the right to use this design, so that it may be followed anywhere without liability to claims for royalty or infringement.

Within the past year or two there has been considerable friction due to enforcing the tank car requirements. This is becoming materially less, and the committee believes that if these requirements are generally enforced, it will require but a comparatively short time to adapt thereto the few cars now remaining to be brought up to the requirements.

The report is signed by A. W. Gibbs, C. M. Bloxham, Robert Gunn.

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SUBJECTS.

*The committee recommends for noon-hour discussions, Convention of 1906:*

Circumferential variation allowable in mating wheels.—To be opened by Mr. George L. Fowler, Consulting Mechanical Engineer, New York.

Piece work on freight car repairs.—To be opened by Mr. Le Grand Parish, Asst. Supt. M. P., L. S. & M. S., Cleveland, Ohio.

Should not the practice to hinge the running boards at the ends, to uncover ice hatches on refrigerator cars, be abandoned?—To be opened by Mr. John S. Lentz, M. C. B., Lehigh Valley R. R., Packerton, Pa.

Should not the uncoupling chains on passenger equipment cars be so arranged as to guard against the uncoupling of cars in transit by passengers who may be on the platform?—To be opened by Mr. F. W. Chaffee, General Inspector, N. Y. C. & H. R., Albany, N. Y.

Advisability of splicing center sills on cars of 50,000 lbs. capacity, or less, in order to perpetuate the cars for two or three years longer with the least expense possible.—To be opened by Mr. F. H. Clark, Supt. Rolling Stock, Pittsburg Coal Co., Coraopolis, Pa.

Methods of handling car scrap and usable material.—To be opened by Mr. R. F. McKenna, M. C. B., D. L. & W., Scranton, Pa.

Desirability of adjusting brake pressure to light and loaded cars.—To be opened by Mr. George W. West, Supt. M. P., N. Y. O. & W. R. R., Middletown, N. Y.

Better fitting up of couplers, even to the point of machining, or at least drilling, the pivot pin hole through coupler lugs and knuckle, with knuckle in place and tail of knuckle forced against lock and proper contour preserved under this condition.—To be opened by Mr. F. W. Brazier, Supt. Rolling Stock, N. Y. C. & H. R., New York.

*Subjects for Committee Investigation During the Year 1906-1907.*

First.—Up-to-date passenger car cleaning.

Second.—By introduction or use of the solid knuckle, would it not be advisable to increase the limit of variation in height of couplers from 3 in. to 4 in., minimum height 31 in., maximum 35 in.

Third.—The present brake head should be made so as to allow the brake beam to hang horizontal as near as possible for either inside or outside hung brakes, at the M. C. B. standards heights of 13 in. for inside and 14½ in. for outside, and make a standard distance between the face of the M. C. B. standard brake shoe and the fulcrum hole of the beam for live and dead lever.

Fourth.—Passenger car ventilation.

Fifth.—Wheels for cars of 100,000 lbs. capacity and the stresses to which they are subjected.

Sixth.—Best location and use of the conductor's brake valve.

The report is signed by James Macbeth, W. E. Fowler, O. M. Stimson, R. P. C. Sanderson, E. E. Davis.

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LOCATION OF SIDE AND END LADDERS ON BOX AND STOCK CARS.

The committee, after a careful consideration of the question, is of the opinion that it is inexpedient for this association to recommend the exclusve use of either side or end ladders. We have not heard of any serious accidents due to uncertainty on the part of trainmen as to the location of ladders. We believe it is the general practice to locate the roof grab irons parallel to the side or end of tue car on which the ladder may be placed, and are of the opinion that this roof grab iron is a sufficient indication as to the location of the ladder. We recommend that the committee on Standards be instructed to modify the M. C. B. sheets and rules covering the loca-

tion of grab irons to show the roof grab irons parallel to the side or end of the car on which the ladders are located, these grab irons to be placed between the limits of 12 or 15 in. from the edge of the car.

The report is signed by W. E. Fowler, Joseph E. Buker, F. H. Clark, T. H. Curtis, W. R. McKeen.

PRICES FOR REPAIRS TO STEEL CARS.

In response to a circular of inquiry the committee received but twelve replies, seven of which recommended that no change be made in the present prices, three recommending that changes be made and two making no recommendations whatever.

After very thoroughly going into this matter, the committee recommends that Rule No. 106, of the 1905 Code of Rules, be changed to read as follows:

"All rivets, 10 cents per rivet, which covers removal and replacing of rivets, including removing, fitting, punching or drilling holes when applying patches or splices, and replacing damaged parts, not to include straightening or repairing."

"Straightening or repairing parts removed from damaged car, 50 cents per 100 pounds."

"Straightening or repairing parts not removed from damaged car; also any parts that require straightening, repairing or renewing, not included on rivet basis, 20 cents per hour."

"Credit for scrap material removed from cars constructed of pressed steel or structural steel, ½ cent per pound."

The report is signed by T. H. Russum, R. F. McKenna, W. F. Eberle, G. N. Dow, E. B. Gilbert, R. W. Burnett, James Macbeth.

AIR-BRAKE HOSE SPECIFICATIONS.

In submitting the air-brake hose report from the Engineering Laboratory of Purdue University, the committee arrived at the following conclusions:

1. It thinks that a chemical standard should eventually be set for the rubber in the tubes and friction. It is believed at the present time that the physical tests which are now the standard of the Association are not conclusive, and from information which has been brought to the attention of the committee during the past year, the committee believes that the government chemists and superintendents of tests, and the chemists of some of the large corporations, have now arrived at a point in connection with tests of rubber where they are able to determine within a very small per cent. the amount of shoddy or substitute which is being used to adulterate the pure gum.

2. It believes that the bursting pressure and chemical analysis of the rubber and grade of duck should eventually make up the specifications. In order to effect this, the committee would recommend that a committee composed of several of the railroad chemists give the matter of chemical analysis a thorough investigation with a view of making a report to the Association.

3. The life of the air-brake hose depends upon the purity of the rubber. This conclusion is arrived at from a study of the report, which shows plainly the rapid deterioration of the inner and outer tubes.

4. The committee is satisfied, from a careful study of the stretching test (Table A), that a physical test will not give any idea of the life of the hose. This leads to the conclusion that it is possible to develop a system of ageing the hose by some thermal or chemical method, which will give a general idea of what the condition of the rubber would be after various periods of service. This will eliminate a great deal of the uncertainty of determining the cause of the failure.

In the foregoing expression as to chemical and other requirements for specifications, the committee does not feel that provision should be included which will throw the burden of maintaining the quality of the hose on to the Association, but on the members thereof.

The Committee desires to bring out strongly the necessity of the safety of air-brake hose, especially on two, three and four-track roads, and the danger to single-track roads when the trains are pulling in on side tracks, which makes the situation equivalent to double-track operation. The necessity for careful inspection of air-brake hose in service is not as apparent to a single-track line as to one operating more than one track, on account of the danger to passing trains. This has been brought very forcibly to the attention of the committee on account of several accidents caused by burst hose, where the train on the opposite track ran into the wreck.

While it is a fact that the purchase of inferior hose will show a low first cost per car per year the subject should be analyzed from another point of view: The operating, purchasing and mechanical departments are all involved. Within the past few years air-brake testing plants have been quite generally introduced at division terminals, for the purpose of knowing the actual condition of the air-brake apparatus previous to leaving the terminal. The educational value of these air-brake testing plants has been enormous, and one of the things brought out prominently is the fact that it is necessary to remove a large number of air-brake hose in order to insure the safety of the trains. Even with this precaution, on lines which are thoroughly equipped with testing plants, serious accidents have occurred due to burst hose.

The interchange of cars is so general that inferior hose applied, where this matter is not considered, does not give the roads proper protection. The relative freedom from damage due to burst hose should be the proper measure of efficiency of inspection and quality of hose.

The committee feels that we should call attention to the mechanical conditions which bring about failure in air-brake hose. Observations lead to the belief that very little advance has been made in eliminating the cause of this damage. The committee has had presented to it report from one of the prominent railroads, which shows conclusively the fact that 85 to 90 per cent. of the failures may be attributed to external or mechanical causes, and cannot be said to be due in any way to the quality of hose.

It is a well-known fact that some roads are now using a cheap hose and thus getting a low cost per car per year. The committee feels that this is not the only object to be considered, but that safety of trains, passengers' lives, and the tremendous cost on account of wrecks, must not be lost sight of.

All of the tests were made under 1903 specifications.

The committee presents a specification for woven and combination wrapped and woven air-brake hose for the consideration of the Association. In submitting this specification the committee has had in mind the necessity of having it in line with the present wrapped hose specification. It is believed that the tensile test will be valuable in determining the quality of the rubber. It will not be possible to present the copyright label for air-brake hose at this time.

*Specifications for Woven and Combination Wrapped and Woven Air-Brake Hose.*

All air-brake hose under this specification is to consist of not less than three plies of woven, braided or knitted fabric, or of two or more plies of canvas wrapping surrounded by at least one ply of woven, braided or knitted fabric. The hose should be flexible without kinking easily. The rubber, fabric or duck should be the best of its kind made for the purpose, and no rubber substitute or short fiber fabric will be allowed.

The inner tubes should be composed of three calenders of rubber and not less than $^3/_{32}$ in. thick at any point. Should a machine-made tube be used, it must not be less than ⅛ in. thick at any point. It must be free from holes and imperfections, and in joining it must be so firmly united to the cotton fabric that it cannot be separated without breaking or splitting the tube. Each ply of the hose should be separated by a distinct layer of rubber, and over this is to be a cover $^1/_{16}$ in. thick and at each end a $^1/_{16}$ in. cap should be vulcanized on, the cover and the cap to be of the same material as the inner tube.

| Age in Months. | Pressure Test. | | | | Friction Test. | | | Stretching Test. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Average Bursting Pressure in Pounds per Square Inch. | Total Number of Tests. | Number of Hose Passing M.C.B. Specifications. | Percent of Hose Passing M.C.B. Specifications. | Number of Hose Passing M.C.B. Specification. | Total Number of Tests. | Percent of Hose Passing M.C.B. Specifications. | Number of Hose Passing M.C.B. Specifications. | Total Number of Tests | Percent of Hose Passing M.C.B. Specifications. |
| 6 | 768 | 73 | 61 | 83.5 | 24 | 73 | 32.5 | 7 | 75 | 9.3 |
| 12 | 752 | 172 | 150 | 87.2 | 57 | 176 | 32.4 | 13 | 173 | 7.5 |
| 18 | 720 | 196 | 153 | 78.0 | 60 | 199 | 30.1 | 7 | 196 | 3.5 |
| 24 | 716 | 117 | 93 | 79.5 | 43 | 120 | 35.8 | 2 | 120 | 1.6 |
| 30 | 684 | 61 | 44 | 72.1 | 17 | 65 | 26.1 | 1 | 64 | 1.5 |
| 36 | 614 | 30 | 14 | 46.7 | 8 | 30 | 26.6 | 0 | | |
| 42 | 688 | 16 | 13 | 81.2 | 5 | 16 | 31.2 | 0 | | |
| 48 | 613 | 7 | 5 | 714 | 0 | | | 0 | | |
| 54 | 598 | 8 | 4 | 50.0 | 0 | | | 0 | | |
| 60 | 800 | 2 | 2 | 100.0 | 0 | | | 0 | | |
| 66 | 620 | 2 | 2 | 100.0 | 0 | | | 0 | | |
| 72 | 565 | 3 | 1 | 33.3 | 0 | | | 0 | | |

**Summary of Results—Table A.**

The hose is to be furnished in 22-in. lengths, and variations exceeding ¼ in. from this length will not be permitted. The rubber caps at each end are not to be less than $^1/_{16}$ in. nor more than ⅛ in. thick. The inside diameter of the hose must not be less than 1⅜ in. nor more than $1^7/_{16}$ in., nor must the outside diameter be less than $2^1/_{32}$ in. nor greater than $2^3/_{32}$ in. The hose must be smooth and regular in size throughout its entire length.

Each hose must have vulcanized to it a badge of white or red rubber as shown; on the top of the badge the name of the pur-

chaser, on the bottom the maker's name, on the left-hand end the month and year of manufacture, and on the right-hand end the serial number and the letters "M. C. B. Standard." The letters and figures must be clear and distinct, not less than $^3/_{16}$ in. in height, and stand in relief not less than $^1/_{32}$ in., so they can be removed by cutting without endangering the cover. Each hose must also have vulcanized to it a badge of rubber showing the copyright, as shown.

Each lot of 200 or less must bear the manufacturer's serial number, commencing at "1" on the first of the year and continuing consecutively until the end of the year, and the serial number should not be duplicated, even though the hose bearing the original numbers be rejected. For each lot of 200, one extra hose must be furnished free of cost.

| RELATION OF WEIGHT OF HOSE TO BURSTING PRESSURE | Including all ages. | | Twelve months of age. | |
|---|---|---|---|---|
| Weight of hose in pounds per foot. | Average bursting pressure in pounds per square inch. | Total number of tests. | Average bursting pressure in pounds per square inch. | Total number of tests. |
| .7 | 320 | 1 | | 0 |
| .8 | 708 | 50 | | 0 |
| .9 | 732 | 219 | 757 | 22 |
| 1.0 | 724 | 267 | 797 | 63 |
| 1.1 | 723 | 103 | 741 | 94 |
| 1.2 | 643 | 38 | 742 | 49 |
| 1.3 | 751 | 5 | 715 | 10 |
| 1.4 | 833 | 3 | 620 | 2 |
| 1.5 | 730 | 2 | 910 | 1 |

**Summary of Results Table B.**

| RELATION OF NUMBER OF TURNS OF CANVAS TO BURSTING PRESSURE | Including all ages. | | Twelve months of age. | |
|---|---|---|---|---|
| Number of turns of canvas. | Average bursting pressure in pounds per square inch. | Total number of tests. | Average bursting pressure in pounds per square inch. | Total number of tests. |
| 2 | 660 | 4 | 645 | 2 |
| 2½ | 740 | 1 | 740 | 1 |
| 3 | 726 | 20 | 636 | 4 |
| 3¼ | 701 | 35 | 788 | 6 |
| 3½ | 661 | 11 | 840 | 2 |
| 3¾ | 630 | 2 | | 0 |
| 4 | 723 | 260 | 759 | 32 |
| 4¼ | 728 | 216 | 755 | 88 |
| 4½ | 714 | 94 | 768 | 30 |
| 4¾ | 681 | 7 | 725 | 4 |
| 5 | 720 | 20 | 737 | 5 |
| 5¼ | 806 | 7 | 880 | 1 |
| 5½ | 754 | 9 | 710 | 2 |
| 5¾ | 670 | 1 | | 0 |

**Summary of Results—Table C.**

*Bursting Test.*—All hose selected for test will have a section 5 in. long cut from one end and the remaining 17 in. will then be subjected to a hydraulic bursting pressure of 400 lbs. per square inch for 10 minutes, which it must stand without failure. At a pressure of 100 lbs. per square inch it must not expand more than ¼ in. in diameter or change in length more than ¼ in., nor develop any small leaks or defects.

*Friction Test.*—A section 1 in. long will be taken from the 5-in. piece previously cut off, and the quality determined by suspending a 20-lb. weight to the separated end, the force being applied radially, and the time of unwinding must not exceed 8 in. in 10 minutes.

*Stretching Test.*—Another section 1 in. long will be cut from the balance of the 5-in. piece and the inner tube or lining will be separated from the ply and cut at the lap. Marks 2 in. apart will be placed on this section and then the section will be quickly stretched until the marks are 8 in. apart and immediately released. The section will then be re-marked as at first and stretched to 8 in. and will remain so stretched 10 minutes. It will then be released and 10 minutes later the distance between the marks last applied will be measured. In no case must the test piece break or show a permanent elongation of more than ¼ in. between the marks last applied. One-inch strips will also be taken from the cover and will be subjected to the same test.

*Tensile Test.*—Another section 1 in. long will be cut from the remainder of the 5-in. piece and the rubber tube or lining will be separated from the ply and cut at the lap. It will then be reduced in the middle for a distance of 2 in. by ½ in. wide parallel. The parallel section shall be spread to the full width of 1 in. at the end by curves of ½-in. radius. This specimen shall be stretched uniformly by gripping the enlarged ends and in no case should the tensile strength per square inch be less than 400 lbs., nor the elongation at the time of failure less than 8 in., measured by marks placed originally 2 in. apart before breaking.

If the test hose fails to meet the required tests the lot from which it was taken may be rejected without further examination and returned to the manufacturer, who shall pay the freight charges in both directions. If the test hose is satisfactory the entire lot will be examined and those complying with the specifications will be accepted.

*Report of Tests Made During the Year.*

The apparatus employed in conducting these tests were the same as used last year, and will be found fully described on pages 114 and 115 in the Proceedings of the Master Car Builders' Association for 1905.

The hose tested were received at the laboratory in lots varying in number from 10 to 37. With but two or three exceptions, all samples of hose subjected to test had been removed from service for the purpose, and ranged in age from one to 72 months. The hose tested were received from 57 different sources.

In the preparation of the hose for test, each specimen was given the same treatment. The sample was first mounted on a hardwood mandrel, placed in a lathe and rotated, and cut into sections by means of a sharp knife supported by the tool rest. The process consisted, first, of removing a section from each end of the hose, of sufficient length to eliminate the enlarged and damaged portion; second, a section 4 in. in length to be used in securing a sample for the stretching test; and third, a section 1 in. in length to be used in determining the friction. The portion of the hose remaining after sectioning was used in determining the bursting pressure. By the process described above, accuracy and uniformity were secured in the form of all test specimens, which in every case were taken from the same relative position in the hose.

The log sheets used in recording results obtained from tests were similar to those used last year, a sample of which will be found in the appendix of this report.

The tests were conducted along the same lines as previously followed, each sample hose being subjected to three distinct tests, namely, bursting, friction and stretching.

In conducting the bursting test, the sample was first carefully fitted with nipples, then filled with water and placed in the machine, where it was subjected to 500 lbs. pressure for a period of 10 minutes. If, after this time, the test piece was uninjured, the pressure was gradually increased until rupture occurred. It might be mentioned, however, that before the sample was fitted with nipples, its weight, length and number of turns of canvas were accurately determined.

The friction samples were carefully prepared, with a view to having the section as nearly as possible one inch in length. The friction was determined for both the outer and inner wrapping, time being taken by means of a stop-watch. When the friction was sufficient to sustain the 25-pound weight for a period of ten minutes without unwrapping six inches, the actual amount unwrapped was recorded. If, however, the friction failed to support the weight for ten minutes, then the time of unwrapping six inches was taken.

The stretching test was made on a longitudinal strip of rubber taken from the inner tube at the lapped or thickest part. In conducting the stretching test, marks two inches apart were first carefully made on the sample. The sample was then placed in the machine and stretched until the distance between the marks measured 10 inches. The stress was then immediately removed and the sample measured to determine the permanent elongation or set. Marks were again placed on the sample two inches apart and the sample again stretched until the distance between the new marks measured 10 inches. The sample was held in this elongated state for a period of 10 minutes, when it was removed from the machine and permitted to shorten for a further period of 10 minutes. At the termination of this time the permanent elongation, or set, was recorded. If, however, the sample failed to stretch to the 10-inch limit, in either case, the actual elongation at rupture was recorded. No trials were made from samples of the outer cover, owing to the uncertain character of the surface.

The time required in removing the stretching sample from the canvas was greatly reduced by applying gasoline to the parts involved. The process also resulted in uniform character of specimens, no cutting with a knife being necessary in separating the

| COMPARISON OF MAKES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Makers | Number of tests | Age in months | Average weight, *per foot | Average number of turns of canvas | Percent passing friction tests: Outer | Percent passing friction tests: Inner | Percent passing stretching test. | Percent passing pressure test. | Average bursting pressure of hose passing pressure test. | Average bursting pressure of hose not passing pressure test. |
| Goodrich Rubber Co. | 21 | 1 to 12 | 1.02 | 4.23 | 66.6 | 71.5 | 14.3 | 95.2 | 786 | 500 |
| N.Y. Belting & Packing Co. | 35 | 1 to 12 | 1.05 | 4.21 | 91.5 | 88.5 | * 11.4 | 85.7 | 745 | 500 |
| U.&G. Rubber Co | 45 | 1 to 12 | 1.06 | 4.18 | 33.3 | 33.3 | 2.2 | 84.5 | 797 | 483 |
| Boston Belting Co. | 9 | 1 to 12 | .91 | 3.92 | 11.1 | 11.1 | 0. | 55.5 | 768 | 495 |
| Cleveland Rubber Co. | 18 | 1 to 12 | .99 | 4.20 | 55.5 | 50.0 | 0. | 94.5 | 814 | 480 |
| Peerless Rubber Co | 28 | 1 to 12 | .99 | 4.18 | 78.5 | 78.5 | 3.5 | 92.2 | 789 | 435[1] |
| Revere Rubber Co. | 24 | 1 to 12 | .97 | 3.95 | 46.0 | 54.0 | 25.0 | 100. | 870 | — |
| Diamond Rubber Co. | 14 | 1 to 12 | 1.12 | 4.09 | 71.5 | 64.2 | 0. | 85.5 | 775 | 450 |
| Goodrich Rubber Co | 30 | 13 to 24 | 1.00 | 4.15 | 60.0 | 46.5 | 6.6 | 86.5 | 769 | 500 |
| N.Y. Belting & Packing Co. | 13 | 13 to 24 | 1.06 | 4.10 | 53.8 | 38.5 | 0. | 92.4 | 765 | 500 |
| U.&G. Rubber Co | 41 | 13 to 24 | 1.05 | 4.11 | 19.5 | 14.6 | 0. | 53.7 | 800 | 415 |
| Boston Belting Co | 33 | 13 to 24 | 1.04 | 4.22 | 11.0 | 6.1 | 0. | 66.0 | 741 | 468 |
| Cleveland Rubber Co. | 14 | 13 to 24 | 1.00 | 4.10 | 78.5 | 71.4 | 0. | 93.0 | 835 | 460 |
| Peerless Rubber Co | 44 | 13 to 24 | 1.02 | 4.15 | 56.9 | 47.7 | 2.2 | 71.5 | 741 | 424 |
| Revere Rubber Co. | 55 | 13 to 24 | .98 | 4.00 | 29.1 | 23.6 | 5.5 | 91.0 | 842 | 370 |
| Diamond Rubber Co | 14 | 13 to 24 | .98 | 3.78 | 42.8 | 38.5 | 0. | 61.5 | 805 | 432 |

**Summary of Results—Table D.**

rubber from the canvas. The effect of the gasoline on the rubber was insignificant, as the actual time required in removing the strip of rubber, in many cases, was only 10 or 20 seconds. To test the effect of the gasoline, a piece of rubber was immersed in gasoline for 20 minutes, after which time a careful examination failed to show the slightest noticeable change in the character of the specimen.

A general summary of results is presented in Tables A, B and C, which were prepared without any special reference to brands or manufacturers.

In the preparation of Table A, the ages of all samples ranging from one month to six months were reckoned as six months of age; all sizes ranging from seven months to 12 months, as 12 months of age; all ages ranging from 13 months to 18 months, as 18 months of age, etc. In the summary of the friction tests, if a sample met the requirements for either the outer or inner wrapping, the sample was considered as passing the M. C. B. specifications.

In Table B, all weights per foot included between 0.61 and 0.70 are given as 0.70; all weights included between 0.71 and 0.80 as 0.80; all weights included between 0.81 and 0.90 as 0.90, etc.

A study of the data obtained discloses the following facts:

1. Seventy-eight per cent. of the total number of hose tested passed the M. C. B. specifications for the bursting test.

2. Thirty-two per cent. of the total number of hose tested passed the M. C. B. specifications for the friction test.

3. Four per cent. of the total number of hose tested passed the M. C. B. specifications for the stretching test.

4. There is a gradual decrease in the bursting pressure with an increase in age.

5. The friction appears to decrease with an increase in age, but not to a very marked degree.

6. As the age increases, the per cent. of samples which pass the M. C. B. specifications for stretching decreases very rapidly.

7. Neither the weight of the hose per foot nor the number of turns of canvas appear to affect the bursting strength of the hose to any great extent.

8. The maximum bursting pressure attained by any sample was 990 pounds.

9. The minimum bursting pressure was found to be 100 pounds.

A piece of the inner tube of each hose was properly labeled and filed away for future use in case any chemical analysis was thought desirable.

While preparing the report on tests of air-brake hose submitted under date of March 8, 1906, it developed that valuable information would be obtained if comparison were made of the results obtained from the tests of hose made by different manufacturers. To this end, Table D was prepared, showing the comparative results of tests of air-brake hose of different manufacturers. At first an attempt was made to prepare this table with reference to brands, but this was found impracticable, since in a great many cases the brand was not given. A total of 35 different manufacturers were represented in the series of tests. Of this number, only eight of the leading manufacturers have been considered because of the comparatively small number of samples tested. It was found that beyond two years of age only a few tests under each condition were available. For this reason the results given are confined to those obtained from samples under two years of age. The table is prepared in two parts. First, on samples ranging from 1 to 12 months of age, and, second, on samples ranging from 13 to 24 months of age.

The report is signed by Le Grand Parish, J. Milliken, T. S. Lloyd and R. L. Ettinger.

### TESTS OF MASTER CAR BUILDERS' COUPLERS.

At the 1905 Convention the standing committee on Tests of M. C. B. Couplers submitted two propositions to the members relative to the method to be pursued in the future to bring about the adoption of a standard design of coupler. The first proposition, reading as follows, was unanimously adopted:

"That the coupler committee be empowered to act in conjunction with a specially appointed committee (in which should be included representatives of the manufacturers) to early decide upon a composite design of coupler which shall contain, as far as possible, the desirable features of the best couplers as now designed, and that all patent rights involved be waived and all manufacturers be permitted to manufacture the composite coupler as adopted."

This committee, composed of five railroad members and five representatives of coupler manufacturers, with Mr. F. W. Brazier as chairman, conferred with the coupler committee and has framed its report to the association, from which it will be seen that it was decided the instructions given could not be carried out and were considered impracticable at the present time, for reasons given in their report.

The report of the committee on Composite Design of Coupler terminated the work of the standing committee on Tests of M. C. B. Couplers for this year, as both committees were working under instructions to early decide upon a composite design of coupler. In view of the action taken by the special committee, the coupler committee now recommends that the second proposition contained in the 1905 report of the coupler committee be adopted to govern the standing committee on Tests of M. C. B. Couplers for the ensuing year, which reads as folows:

"That the present policy of the association be followed out, that is, that the gradual improvement of the M. C. B. standard coupler and the elimination of poorly designed and weak couplers be carried on as at present, by making the requirements to be met by the M. C. B. coupler more and more rigid, thus compelling a higher degree of efficiency closely prescribing the limits for the future within which designers may work, while at the same time in no way preventing beneficial competition."

There are several slight inaccuracies and omissions in the M. C. B. drawings of standards and recommended practices in the Proceedsings of 1905, for coupler and coupler yoke, to which the committee draws attention as follows:

M. C. B. Sheet 11. End view of coupler at bottom of sheet shows slotted instead of solid knuckle. As the solid knuckle has been adopted as standard, the drawing should be changed accordingly.

M. C. B. Sheet "B." Yoke for twin-spring gear and yoke for tandem-spring gear shows a dimension of 6⅛ in. between legs of yoke. These yokes were designed for the 6½-in. coupler butt and therefore this dimension should read 6½ in. The over-all dimension of 9 in. (over legs of yoke) is correct and the 6⅛ in. is a typographical error and should be corrected.

M. C. B. Sheet "B." There is no 5 by 5½ by 6½-in. butt shown on this sheet with 1 5-16 in. holes for the 1¼-in. rivets adopted as recommended practice. Inasmuch as the yokes are shown for this size butt, the coupler butt should be included on this sheet.

As the above corrections and additions do not involve any changes in the standards or recommended practices as adopted by the association, the coupler committee recommends that the secretary be instructed to incorporate the same in the drawings.

The report is signed by R. N. Durborow, J. E. Buker, Theo. H. Curtis, F. H. Stark.

### REVISION OF PASSENGER CAR RULES.

*Code of Rules Governing the Condition of and Repairs to Passenger Equipment Cars in Interchange.*

1. Each railroad shall give to foreign cars, while on its line, the same care and attention that it gives its own cars, except in case of cars on which work is done under special agreement existing between the company owning the cars and the road operating the same.

2. The expenses of maintenance of passenger equipment operated in interchange or line service, shall be divided into three classes, namely:

(a) Owner's defects.

(b) Delivering company's defects.

(c) Line expenses pro-ratable against the roads comprising the lines on a mileage basis.

3. (a) Owner's defects are those due to ordinary wear and tear.

(b) Delivering company's defects are those due to unfair usage, derailment or accident. Delivering company is solely responsible to car owners for any improper repairs made by them.

(c) Line expenses shall consist of the expense of terminal cleaning, lubrication (oil, waste, tallow and labor), lighting (oil, wicks, chimneys, burners, shades, gas, candles and broken glass).

4. The railroad making the repairs for the defects not proratable against the line is privileged to bill the car owner for these repairs, unless there is evidence to indicate that the damage was occasioned by unfair handling on the part of the delivering company.

5. Information as to mileage made by cars must be furnished promptly on request of owners by railroads over which cars are run.

6. (a) Cars shall be thoroughly oiled at terminals.

(b) No charge to be made for lubrication at intermediate points.

7. Only one journal bearing per journal may be charged per trip.

8. No labor charge shall be made for applying brake-shoes, journal bearings, hose (air, steam or signal) or for icing, filling lamps, gassing tanks or coaling cars.

9. No credit to be allowed for scrap brake-shoes removed.

Note.—Steel back brake-shoes not to be removed if over ½ in. thick; grey iron shoes not to be removed if over ¾ in. thick.

10. Loss of metal from tires of steel-tired wheels, caused by flat sliding, is chargeable to the company on whose road the damage is inflicted.

Note.—Loss of service metal from steel-tired wheels as a result of sliding to be measured from point where slide begins. One-sixteenth inch of metal to be allowed for flat spots under 2½ in. long and ⅛ in. of metal to be allowed for flat spots 2½ to 3½ in. in length, both inclusive.

11. (a) Axles broken under fair usage or having journals

½ in. or more under the standard for car (except for 3¾ by 7, which will be condemned at 3½ in.) may be renewed at the expense of the car owner.

(b) Cut journals, axles bent or broken or rendered unsafe by unfair usage, derailment or accident, shall be renewed at the expense of the railroad on whose line damage is inflicted.

(c) Where necessary to true up axles in cases of cut journals, where the journal is reduced below the limit as prescribed in Rule 11*a*, axle must be changed at the expense of company cutting journal.

12. Charge for car heating to be 10 cents per day per car. Cars lying at stations for over 48 hours, expense of heating to be borne by railroad in whose possession cars may be.

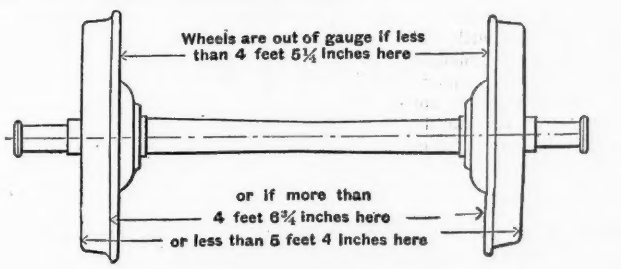
13. (a) Brakes must be in perfect working order. Cylinders and triple valves must have been cleaned and oiled within six months, and in case of cars equipped with high-speed brakes, triple and high-speed valves must be cleaned every three months and date of last cleaning and oiling stenciled on brake cylinder and triple valve with white paint.

(b) The adjustment of piston travel based on not less than 70 lbs. initial pressure must not be less than 5 in. nor more than 8 in.

*Defects in Wheels—Owners Responsible.*

14. (a) Loose wheels.

(b) Variation from gage if less than 4 ft. 5¼ in. inside of wheel at flange, or, if more than 4 ft. 6¾ in. outside of flange or less than 5 ft. 4 in. outside of tread.




*Wheels—Cast-Iron.*

15. (a) Shelled out; wheels with defective treads on account of pieces shelling out; if the spots are over 1 in. or so numerous as to endanger the safety of the wheel.

(b) Tread worn hollow; if tread is worn hollow ⅛ in. or over.

(c) Worn flanges; flanges having flat vertical surfaces extending more than ¾ in. from tread, or, flanges less than 1⅛ in. thick.

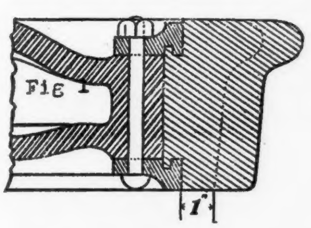
(d) Burst; if wheel is cracked from wheel fit outward by pressure from axle.

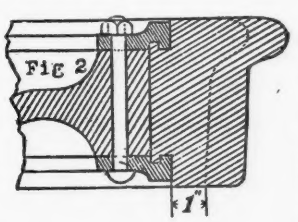
(e) Flange, rim, tread, plate brackets or any other part of wheel, either cracked, chipped or broken under fair usage.

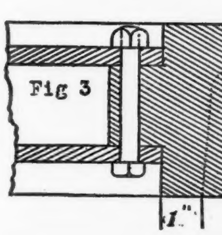
*Wheels—Steel Tired.*

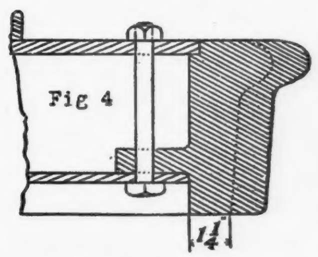
16. (a) Loose, broken or cracked hubs, plates, bolts, retaining ring or tire, occurring under fair usage.

(b) Worn flange or tire; with flange less than 1 in. thick or having flat vertical spot extending more than ¾ in. from tread, or with tire thinner than shown in Figs. 1, 2, 3 and 4.




*Delivering Company Responsible.*

17. Flat spots; if flat spots, caused by sliding, exceed 1 in. in length.

18. (a) If a car is transferred from the service of one railroad to that of another, the receiving road shall issue gas certificate authorizing the delivering road to bill against it for the number of atmospheres of gas and number of holders at the time car was received.

(b) Cars in interchange requiring holders to be filled, the receiving road shall be charged for the quantity of gas supplied.

(c) For cars stored in shops for repairs the company having car in its possession shall be responsible to the delivering company for the gas in holders. This will apply to sleeping-car companies when cars are in their possession and out of service.

19. The depreciation of all passenger equipment cars due to age shall be 3 per cent. per annum, to continue not to exceed 50 per cent. of the original value of car body. The depreciation of trucks shall be 3 per cent. per annum, to continue not to exceed 50 per cent. of the original value. No depreciation shall be allowed on the value of air-brakes.

20. This code of rules is understood to apply to all equipment interchanged in passenger trains.

21. Bills for line charges shall be made and rendered monthly and prices for materials and labor shall be in accordance with accompanying schedule.

22. This Code of Rules shall take effect Sept. 1, 1906. The committee make recommendation that specifications be prepared for standard steam and signal hose.

Air-brake hose applied subsequent to Sept. 1, 1906, must be made in accordance with M. C. B. specifications and so labeled.

..........................................................
(Name of road.)
GAS CERTIFICATE.
..........................................................
Car No................ Initial..............
No. of Atmospheres.........................
No. of Holders ..............................
Size of Holders .............................
.......................Station, ...................190....
..............................Inspector.

*List of Prices Agreed Upon for Expenses of Maintenance of Passenger Equipment in Interchange.*

| | | New. | S. H. | Scrap. |
|---|---|---|---|---|
| 1. | Axles, 4¼x8 in. | $14.00 | $7.75 | $5.25 |
| | Axles, 3¾x7 in. | 12.00 | 6.50 | 4.50 |
| 2. | Burners, round wick, each | | | .50 |
| 3. | Burners, dual wicks, each | | | .30 |
| 4. | Bell or signal cord and couplings, per car | | | .75 |
| 5. | Bearings, journal, applied, per lb. | | | .16 |
| 6. | Bearings, journal, credit for scrap bearing one-half weight of new bearing, per lb. | | | .11 |
| 7. | Bolts, nuts, and forgings, per lb. | | | .03 |
| 8. | Bolts, nuts and forgings, credit, per lb | | | .00¾ |
| 9. | Bowls, opal, gas, 9-in., each | | | .50 |
| 10. | Chimneys, round, wick, each | | | .11 |
| 11. | Chimneys, dual wick, each | | | .06 |
| 12. | Candles, per lb. | | | .15 |
| 13. | Coal (including labor), per ton. | | | 6.00 |
| 14. | Chain, per lb. | | | .05 |
| 15. | Chain, credit, per lb. | | | .01 |
| 16. | Cleaning parlor and sleeping cars, exclusive of bedding, per car | | | 1.35 |
| 17. | Cleaning vestibuled passenger and combination cars, each | | | .85 |
| 18. | Cleaning common passenger and combination cars, each | | | .50 |
| 19. | Cleaning vestibuled baggage and mail cars, each | | | .50 |
| 20. | Cleaning common baggage and mail cars, each. | | | .30 |
| 21. | Taking out carpets, seats, draperies, etc., from parlor and sleeping cars and beating them, per car | | | 1.00 |
| 22. | Taking out and beating cushions and backs of seats of passenger cars, either vestibuled or common, per car. (No additional charge for cleaning trucks of parlor or sleeping cars.) | | | .65 |
| 23. | Domes, gas, each | | | .50 |
| 24. | Diamond S brake-shoes, applied, each | | | .50 |
| | Diamond S brake-shoes, no credit for scrap. | | | |
| 25. | Gas, Pintsch, per receiver. | | | .85 |
| 26. | Globes, gas, 4-in., each. | | | .50 |
| 27. | Globes, opal, gas, each. | | | .50 |
| 28. | Glass, per light | | | At Cost. |
| 29. | Glass, setting, per light | | | .25 |
| 30. | Hose, air-brake or signal, complete with fittings, applied to car, each: | | | |
| | 1-in. air signal | | | 1.75 |
| | 1¼-in. air-brake | | | 2.00 |
| 31. | Hose, air-brake or signal, credit for fittings. | | | .80 |
| 32. | Hose, 1½-in. straight port, steam, complete with fittings, applied to car | | | 6.50 |
| | 1-in. | | | 5.00 |
| 33. | Hose, 1½-in. steam, credit for fittings | | | 5.25 |
| | 1-in. | | | 4.00 |
| 34. | Ice (including labor), per cwt. | | | .30 |
| 35. | Iron, cast, per lb. | | | .01¾ |
| 36. | Iron, cast, credit per lb. | | | .006-10 |
| 37. | Iron, malleable, per lb. | | | .03 |
| 38. | Iron, malleable, credit, per lb. | | | .00½ |
| 39. | Labor, on lubrication, per hour | | | .20 |
| 40. | Labor, on repairs, per hour. | | | .25 |
| 41. | Lumber, oak, pine, hickory, poplar, and elm, per ft. | | | .03 |
| 42. | Oil, Galena, car, per gal. | | | .22 |
| 43. | Oil, Galena, coach, per gal. | | | .35 |
| 44. | Oil, illuminating, American roads to charge, per gal. | | | .11 |
| 45. | Oil, illuminating, Canadian roads to charge, per gal. | | | .16 |
| 46. | Shades, acme, lamp, each | | | .45 |
| 47. | Shades, common lamp, each. | | | .25 |
| 48. | Steel, spring (not springs), per lb. | | | .04 |
| 49. | Steel, spring, credit, per lb. | | | .00¾ |
| 50. | Steel castings, per lb. | | | .04½ |
| 51. | Steel castings, per lb. | | | .04¾ |
| 52. | Tallow, per lb. | | | .06 |
| 53. | Waste, woolen, per lb. | | | .12½ |
| 54. | Waste, cotton, per lb. | | | .06 |
| 55. | Wicks, round, each. | | | .02 |
| 56. | Wicks, dual, each. | | | .00½ |
| | | New. | S. H. | Scrap. |
| 57. | Wheels, cast, 36-in. | $10.00 | $7.50 | $5.00 |
| 58. | Wheels, cast, 33-in. | 8.50 | 6.75 | 4.50 |
| 59. | Wheels, new, steel | | | Cost. |
| 60. | Wheels, second-hand and scrap, steel, $1 per 1-16-in. in thickness of tire, unless tires are loose or broken. | | | |
| 61. | Loss of metal from steel-tired wheels, $2.00 per 1-16-in. | | | |
| 62. | Labor, changing, per pair. | | | 2.00 |
| 63. | Removing, turning and replacing steel-tired wheels | | | 7.00 |
| 64. | Steel-tired, cost of retiring to be cost with addition of freight charges. | | | |

The report is signed by F. W. Chaffee, G. W. Wildin, J. E. Buker, F. N. Hibbits, J. T. Chamberlain.

BRAKE BEAMS.

*Inefficient Brake Beams.*

A large number of brake beams now being used do not even meet the specifications of 1889. The result is that such brake beams not only give inefficient service but soon fail.

Investigation shows that many new freight cars have been equipped with brake beams hung at variance with the M. C. B. standard height, also at variance with the height for which the brake beams were designed. This misapplication produces a torsional strain on the beams when the power is applied.

Many roads are still applying "outside hung" brake beams, which we believe is radically wrong, as it is impossible to obtain satisfactory results with beams so hung. Outside hung beams are affected by the action of the bolster springs, curving of the trucks, sagging of the car body, etc., all of which prevents effective braking, and particularly under the varying conditions of loaded and empty cars. There is no argument in favor of such an arrangement, with the one exception, that they are more accessible.

A brake-beam should be hung inside of the wheels to some *rigid* portion of the truck, so that it will always maintain the same relative position to the wheels; when so hung the beams are easier to maintain, and not being exposed are less liable to be struck by obstructions on the track (impromptu bumping posts, etc.). The first cost of the inside hung brake-beam is less, they cost less to apply, and most important of all, give more effective results in braking.

*Vertical Stress.*

Owing to the large number of brake-beams which have become twisted or buckled in service, some have asserted that brake-beams are subjected to a severe "transverse" or vertical stress. From a mechanical standpoint there can be practically no "transverse" stress produced in a brake beam in service. Even under extreme misapplication, which produces *torsional* or twisting strains, only a nominal amount of "vertical" stress will result. The question therefore naturally arises, why do some brake beams become twisted or buckled in service? This is due to the use of brake beams which do not have sufficient strength in the normal line of pull. Being overloaded they fail and naturally in the line of least resistance, this being "transversely" or up and down in relation to the position of the beam on the car. If the proper *stiffness* in the *normal line of pull* is specified and used, the vertical strength will be sufficient. This has been further demonstrated by the satisfactory service of thousands of brake beams of proper design, and strength, on light weight and low capacity cars, such service covering a long period of years.

A brake beam cannot be subjected to *any* stress or strain in service until the brakes are applied, and then any strains, other than those due to the applied power, must come from the rotation of the wheels, or if the brake beam is misapplied, from the improper contact of the brake shoes on the wheel. The rotation of the wheels, owing to the friction of the brake shoes, has a tendency to move the brake beam up or down, as the case may be. This tendency is resisted and overcome by the brake hangers, which transmit the *stresses directly* from the brake heads and shoes to the truck frame, to which the hangers are rigidly attached. It is therefore apparent that this action, which is limited to the play of the brake hangers, does not produce any stress at the center of the brake-beam. (See Fig. 1 showing the line of forces.)

If a rigid head beam is hung at a height other than that for which it was designed, one end of the brake shoe will naturally come in contact with the wheel before the other, and on being forced into full impact by the application of the brakes, will cause, not transverse, but *torsional* stresses, or a twisting of the brake beam about its own axis, the greatest stresses being produced at or near the brake heads.

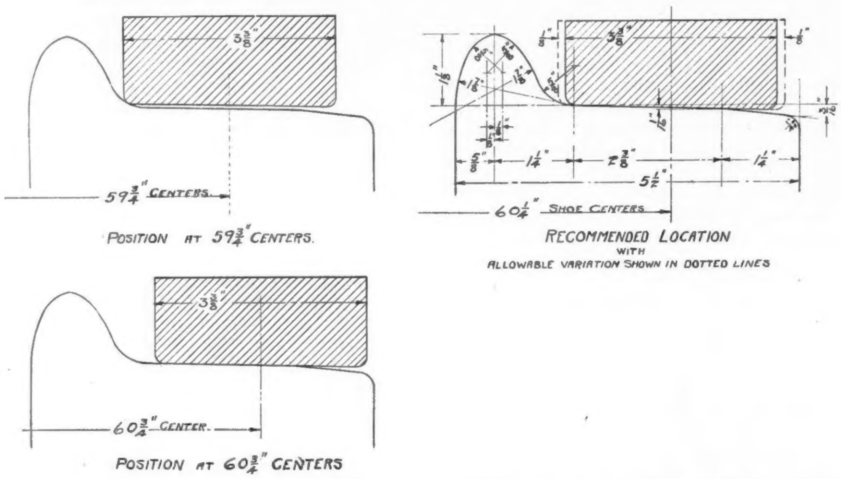
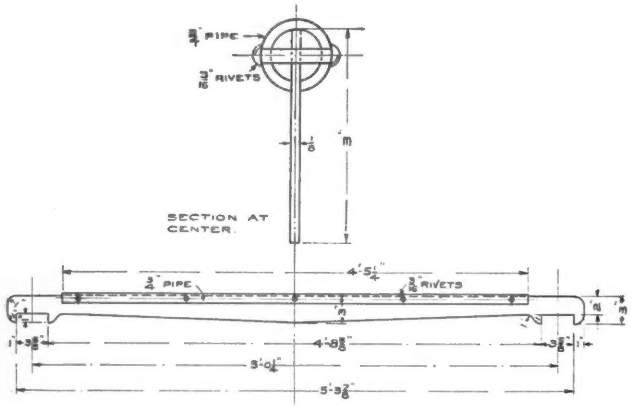



**Fig. 2—Relation of M. C. B. Brake Shoe to Wheels of M. C. B. Standard Gage and Contours.**

The use of automatically adjustable brake heads will take care of all conditions of application, and eliminate any and all stresses on the brake beam structure, other than those produced by the normal braking force or lever pull.

The real cause of the many failures of brake beams attributed to "transverse" or vertical load, is the overloading of a structure which is primarily too weak, and where the line of least resistance is at right angles to the lever pull, resulting in the buckling of the beam in a vertical direction.

Many brake beams are used to-day on equipment where the service loads are double the capacity of brake beams at the allowable deflection of $^1/_{16}$ in. Investigation of this subject also shows that the types of brake beams which have sufficient normal capacity even when they have *little* "vertical" strength, give satisfactory service, and do not show any weakness or tendency to fail by cross-bending, while other types of brake beams, of much greater vertical strength, but less normal stiffness, have failed in the same service. Some of the brake beams now being used in the most exacting service ("high speed" passenger service) and which are proving




*RECOMMENDED*

*M.C.B. STANDARD BRAKE BEAM GAUGE.*

**Fig. 3.**

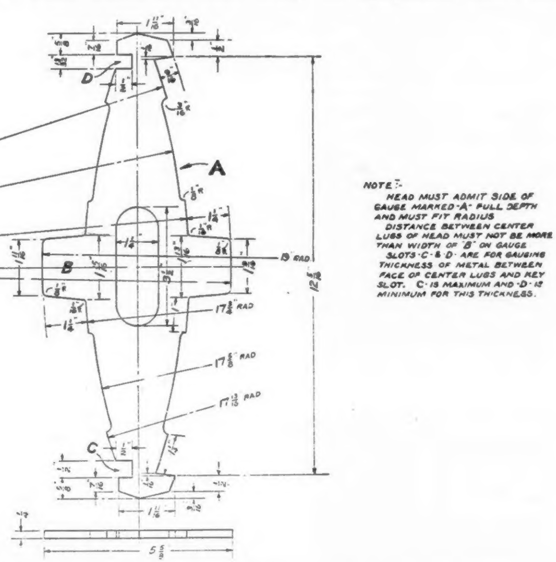



**Fig. 5—Recommended M. C. B. Standard Brake Head Gage.**

most satisfactory, have less "transverse" strength than many of the light types of freight brake beams which fail by buckling in ordinary freight service, where the requirement is very much less than the "high speed" service.

*Capacity.*

When it is considered that some 60,000-lb. capacity furniture and rifregireator cars weigh over 50,000 lbs., and that some 100,000-lb. capacity flat and gondola cars weigh as little as 30,000 lbs., it will be seen that the mere "capacity" of a car can hardly be used as the basis of determining this question. The *load applied to the brake beam* is what we wish to determine, and under the present conditions this is fixed by the light weight of the car, and the ratio

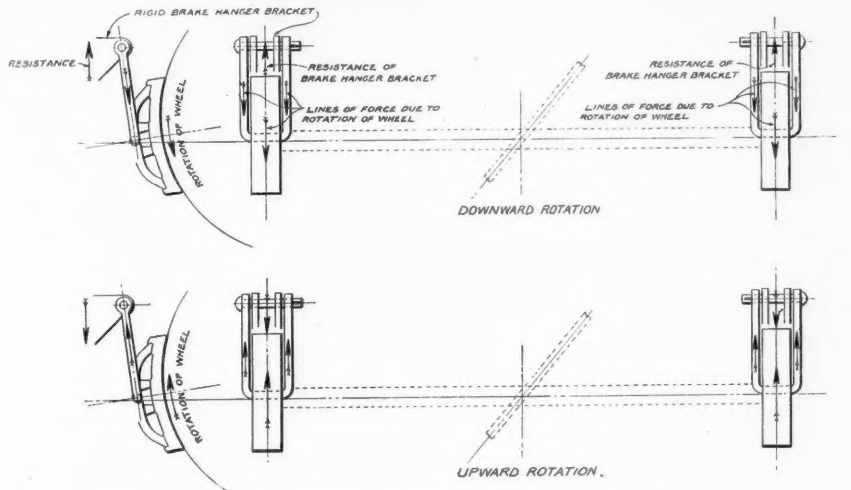



**Diagram of Brake Beam and Hangers Showing Lines of Force Due to Friction of Shoes on Wheels.**

of braking power to same. This condition will obtain until some method is adopted for braking in proportion to loaded and empty cars.

While there is considerable variation in the weight of cars, the disadvantage of having two or three capacities of beams in addition to the different makes now in use will be apparent, and after a careful consideration of this question, it is believed that one new standard should be arrived at, which will take care of the maximum conditions, but the use of the present M. C. B. No. 1 beam (7,500-lb. capacity) should be permitted where the car does not exceed 30,000 lbs. in weight, and braking power does not exceed 70 per cent. of light weight of the car. This will admit of the continued use of all brake beams that meet the present standard of 7,500-lb. load with only $^1/_{16}$ in. deflection, on this light equipment, but will give a common standard for all cars weighing more than 30,000 lbs., which will practically include all new and modern cars.

Further application of brake beams which do not meet the present M. C. B. requirements should be abandoned, and after a specified date such beams should be refused as improper material for interchange.

In arriving at the desired working capacity, we may assume 50,000 lbs. as the maximum weight of line or general service freight cars; there may be some instances of special construction where this weight is slightly exceeded, but these exceptions need not be considered in view of the allowance to be made later. Now, assuming 1,500 lbs. unbraked weight per axle as a minimum which can be allowed to avoid slid flat wheels, and we will have a maximum braking power of 50,000 lbs., less 6,000 lbs., or 44,000 lbs.; this divided by four gives a maximum braking force of 11,000 lbs. per beam. Adding to this value a reasonable factor of safety necessitates a capacity in the brake-beams of 15,000 lbs.

*Deflection.*

In establishing the proper capacity of beams the present M. C. B. allowable deflection of $^1/_{16}$ in. has been used, it not only being the recognized standard by which to measure all capacities of brake-beams, but experience has shown that this can be easily met in economical design, and it also leaves sufficient elasticity to withstand the shocks of service without injury or permanent set.

*Length of the Brake Beam.*

Manufacturers are now called upon to furnish three different

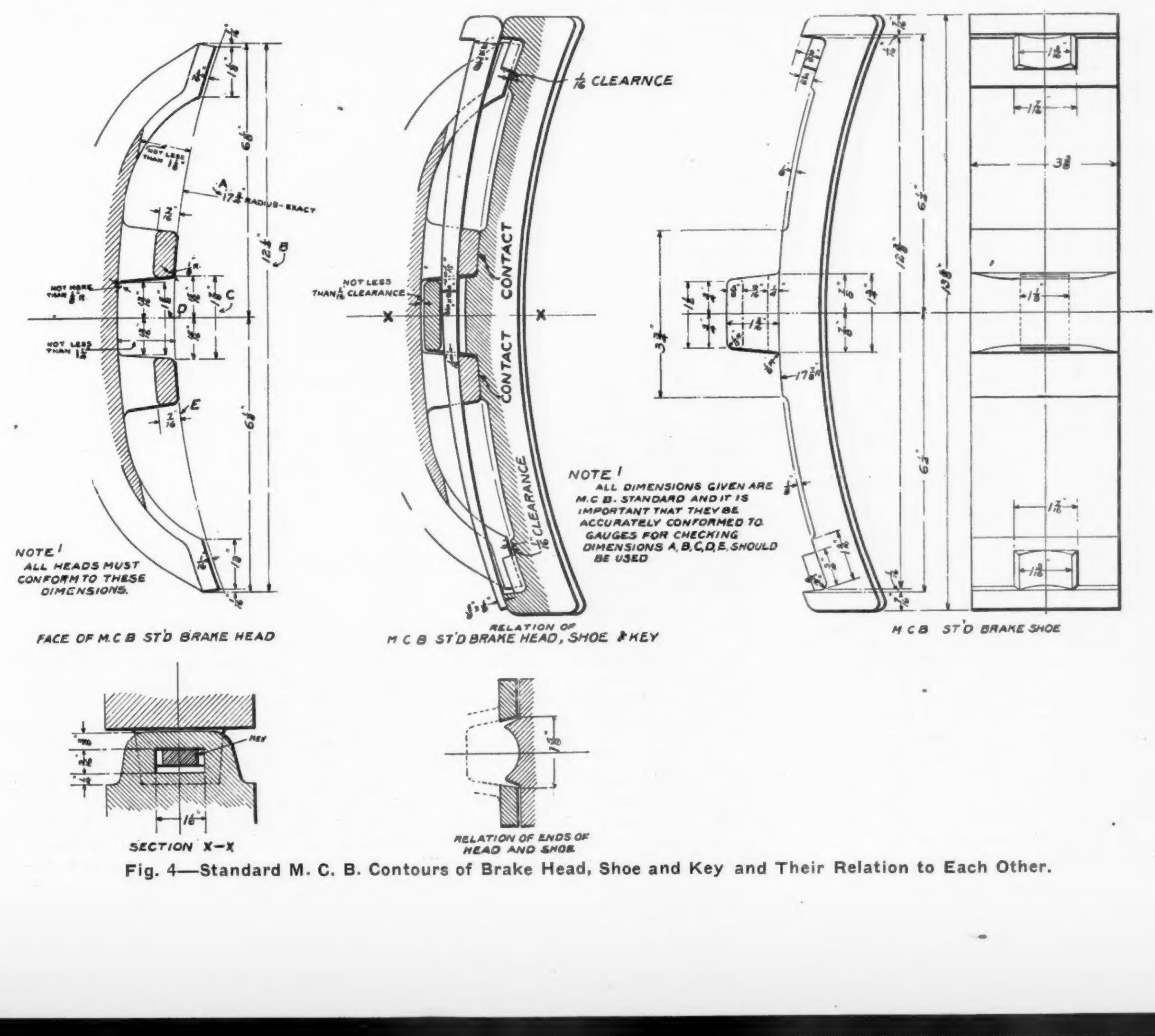



**Fig. 4—Standard M. C. B. Contours of Brake Head, Shoe and Key and Their Relation to Each Other.**

lengths of brake beams, namely; 60 in., 60¼ in. and 60½ in. center to center of brake shoes. This with allowable and unavoidable variations of ¼ in. in manufacturing, gives the extremes in length of 59¾ in. and 60¾ in.

Fig. 2 shows the position of the standard shoe on the wheels at the two extremes of 59¾ in. and 60¾ in. It will be noticed that both of these positions are objectionable; in the former case the shoe crowds into the throat of the flange of the wheel; and in the latter instance encroaching so closely to the outer edge of the tread of the wheel, that with a slight variation in hanging, it would overlap. The present M. C. B. standard of 60½-in. centers would be satisfactory if it were not exceeded or could be maintained. The usual variation of ¼ in. either way from the specified length, allowed by most railroads, does not seem to be too much. This allowance, with the present standard of 60½ in., would permit of brake-beams being made 60¾ in., which is too long, and with beams specified at 60 in. from center to center it would admit of beams being made 59¾ in. long, which would cause the shoe to crowd into the throat of the wheel. It would therefore seem best to decide upon the mean of 60¼ in., with an allowable variation of not over ⅛ in. either way. This would then give us the extremes of 60 in. and 60½ in., neither of which lengths is objectionable when not exceeded. (See Fig. 2, showing position of shoe on the wheel at 60¼-in. centers, with the allowable variation from this length shown in dotted lines.)

We recommend that the association specify that all brake-beams should be 60¼ in. from center to center face of the brake heads with an allowable variation of not over ⅛ in. either way from this dimension. Gage shown on Fig. 3 should be adopted as standard for checking these dimensions and measurements should be taken at the center and at each end of the brake heads.

*Brake Heads.*

Difficulty has been experienced in fitting the brake shoes on many of the brake heads now on the market, because the brake heads do not conform to the M. C. B. dimensions. Fig. 4 shows the relation of the M. C. B. standard Christie brake head and brake shoe. The plan contemplates contact or bearing at the center lugs of the brake head, while the ends of the brake head clear the back of the brake shoe, their function being merely keep the shoe in vertical alinement while the center lugs transmit the load directly to the beam and fit the shoe lug so snugly as to prevent any upward or downward movement of the shoe. In practice a great deal of play is often found at this point, which is very objectionable, as it allows the shoe to chatter up and down with the rotation of the wheels. Also many brake heads are found which bear at the ends and lack contact at the center, causing the shoes to break at the center when worn. Many brake heads also will not allow the brake shoe key to be properly driven into place.

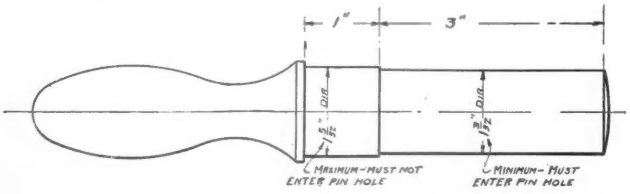


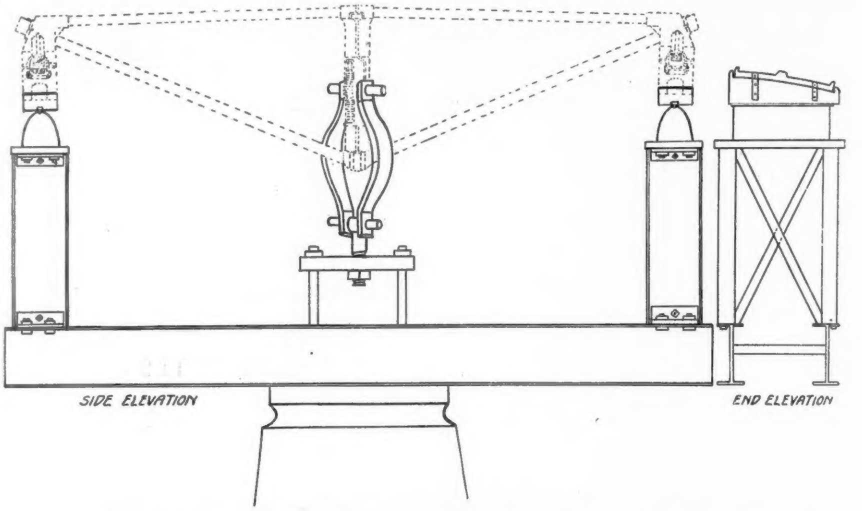

**Fig. 6—Lever Pin Hole Gage.**

All of these difficulties can be remedied by specifying that all brake heads shall be made in conformity to present standard dimensions, at least in the essential points. In order to insure these results the gage shown by Fig. 5 should be adopted as standard with which to check up these dimensions.

It is important that all brake heads be of such an angle in relation to the center line of the fulcrum, or the normal line of applied force (which is horizontal), that the shoes shall be in perfect contact with the tread of the wheels when applied. When rigid heads are used they should be designed for the particular height at which they are to be hung. Brake beams with adjustable heads can be hung at any height.

*Lever Fulcrums.*

The present M. C. B. standard angle of 40 deg. from the vertical for the lever slot is now almost universally used on freight brake beams and should be maintained as a standard. The present M. C. B. standard lever pin which is 1 3-32 in. in diameter is also generally used and should be maintained, having ample shearing and bearing value for a brake beam of the increased capacity previously recommended, but the *diameter of the lever pinhole* in the brake beam fulcrum should have our attention. Inspection has shown that the standard of 1⅛ in. in diameter in many instances is not being adhered to. Many brake beams have pinholes roughly cored, and both too large in diameter and out of round, many being found 1 3-16 in. to 1¼ in. in diameter. It is very important that these pinholes do not exceed 1⅛ in. in diameter, so as to eliminate lost motion as well as to reduce the wear at this point. The tendency to wear increases very rapidly in proportion to the amount of play. In the case of malleable iron fulcrums these holes should be drifted (not drilled) to size. In the case of wrought iron or steel fulcrums, these holes should be drilled or punched and reamed to size. In order to check and maintain a 1⅛-in. pinhole a gage should be adopted for this purpose, and such a gage limiting the variation from the exact size desired is herewith submitted. It will be noted by reference to Fig. 6 that the small diameter of the gage pin, which must enter the fulcrum hole, is 1 3-32 in., or the same diameter as the lever pin. The larger diameter of the gage pin, which is 1 5-32 in. in diameter, must *not* enter the fulcrum hole, and is only 1-32 in. larger than the desired diameter.




**Method of Testing Showing Arrangement in Machine in Direct Test.**

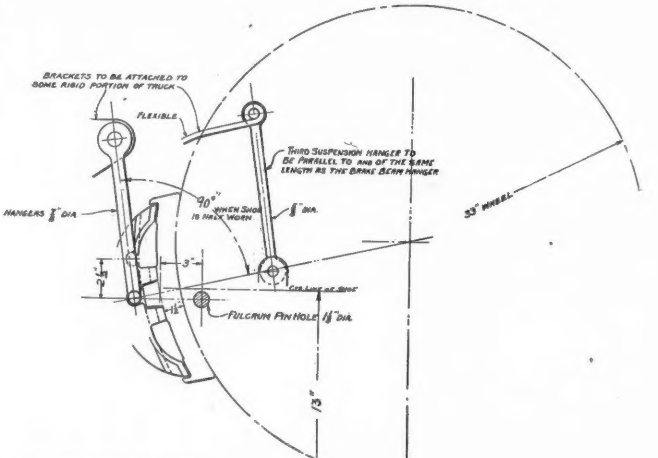



**Fig. 7—Recommended Application of Inside Hung Freight Brake Beams.**

While there is at present a wide range of variation in the position of the pinhole of freight brake beams, the majority (probably 80 per cent.) are located approximately either at 2 in. or 3 in. in front of the face of the brake heads. The latter dimensions would probably be preferable. This would bring the pinhole 1½ in. forward of the face of a standard 1½-in. thick brake shoe. The position of the lever pinhole should be specified in relation to the face of the *brake heads*, and not the brake *shoes*. In order to insure uniform results this dimension, whatever may be determined upon, should be limited to not over 1-16 in. variation either way.

The committee would recommend that 3 in. be made the stand-

ard distance from face of brake head, measured from the center on line of curve on top of lugs to center of lever pinhole. (See Fig. 7.)

*Application.*

As the best results can only be obtained when beams are insiae hung, we recommend to the association that all brake beams be inside hung, and that the present M. C. B. standard height of 13 in. from top of rail to the center of the face of brake shoes be adhered to on all new equipment. When this height can not be obtained on old equipment, it is recommended that the beams be hung as high as possible; if provided with rigid heads they should be designed to suit the height at which they are hung. In all cases the lever fulcrum and the center line of the brake beam should be horizontal, which is in line with the applied power. In addition to the above we recommend this association adopt as recommended practice the following features of application as shown on Fig. 7, namely:

All brake hangers should preferably be attached to the brake head at the center of same, just back of the central brake shoe lug so that they will be firmly locked in position by the brake shoe, and by bringing them as close to the shoes as possible, overcoming the tendency of the beam to rotate about the hangers. This will also admit of the use of longer brake hangers, than if they were attached to the brake heads at a point above the center of same, and which is a desirable feature.

Where by reason of design of brake beam the recommended location of brake hanger eye is impracticable an alternate location 2½ in. above the preferred location for brake hanger eye as shown by Fig. 7 is permissible.

The slot for the brake hanger should be limited in dimension as much as possible, in order to prevent wear and overcome the chattering or excessive movement of the beams up and down with the rotation of the wheels. In order to obtain a minimum play at this point of attachment, a standard size hanger ⅞ in. diameter should be adopted, and this size is now in general use.

In order that the proper release of the brake beam be obtained by gravity, the brake hangers should have an angle as nearly as possible to 90 deg. from a line drawn from the center of the brake shoe to the center of the axle when the shoes are half worn. This will also prevent any possible wedging of the beams.

Third suspension hangers should be used on all brake beams when practicable to prevent the shoes from dragging on the wheels when the brakes are released. They should be attached to flexible (not rigid) brackets, and should have the same exact angle and length as the brake hangers to prevent binding or tilting of the beam.

Chains are preferable for safety hangers, as the yoke and similar forms of safety attachment are often so arranged that they strike the beams, causing a loss of power and a tendency to damage the beam.

Fifty-one inches center to center of safety hangers is now generally used and should be adopted as standard.

*Facilities for Testing Brake Beams.*

In order to insure that purchasers obtain brake beams which

## DIRECT TEST.

| Lab. No. | NAME. | Make-Up. | Weight. | Mark. | LOADS AND DEFLECTIONS. 7,500 Load. | 7,500 Deflection. | 7,500 Set. | 15,000 Load. | 15,000 Deflection. | 15,000 Set. | Elastic Limit. Load. | Elastic Limit. Deflection. | Elastic Limit. Set. | AT MAXIMUM. Load. | AT MAXIMUM. Strength per Lb. of Beam | Resilience. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Lbs. | Inch. | Inch. | Lbs. | Inch. | Inch. | Lbs. | Inch. | Inch. | Lbs. | | Lbs. |
| 4 | Simplex.......... | Solid | 95.00 | C-2 | 7,500 | .098 | .000 | 15,000 | .188 | .000 | 17,000 | .217 | .000 | 21,000 | 221.0 | 1844.5 |
| 5 | Simplex.......... | Solid | 124.00 | F-2 | 7,500 | .062 | .000 | 15,000 | .135 | .006 | 16,000 | .146 | .010 | 22,500 | 181.5 | 1168.0 |
| 15 | Simplex.......... | Truss | 137.75 | G-1 | 7,500 | .018 | .000 | 15,000 | .035 | .001 | 24,000 | .060 | .006 | 50,000 | 363.0 | 720.0 |
| 18 | Simplex.......... | Truss | 131.50 | H-1 | 7,500 | .022 | .000 | 15,000 | .044 | .003 | Inde | finite. | | 61,900 | 470.6 | ......... |
| 1 | Davis........... | Truss | 94.75 | B-1 | 7,500 | .040 | .005 | 15,000 | .086 | .017 | Inde | finite. | | 42,000 | 443.2 | ........ |
| 7 | Pressed Steel ..... | Solid | 85.25 | A-1 | 7,500 | .100 | .000 | 15,000 | .211 | .025 | 14,000 | .192 | .010 | 21,000 | 246.4 | 1344.0 |
| 6 | Pressed Steel ..... | Solid | 92.25 | Extra | 7,500 | .085 | .000 | 15,000 | .172 | .005 | 16,000 | .185 | .005 | 24,575 | 266.3 | 1480.0 |
| 8 | Monarch ......... | Solid | 82.50 | S-1 | 7,500 | .101 | .000 | 15,000 | .......... | ...... | 12,000 | ..170 | .005 | 15,575 | 188.8 | 1020.0 |
| 12 | Sterlingworth. .... | Solid | 88.00 | R-1 | 7,500 | .110 | .000 | 15,000 | .231 | .015 | 14,000 | .210 | .010 | 23,675 | 269.0 | 1470.0 |
| 23 | Diamond......... | Truss | 157.50 | E-2 | 7,500 | .053 | .000 | 15,000 | .085 | .001 | Inde | finite. | | 56,890 | 361.2 | ....... |
| 17 | Central .......... | Solid | 80.75 | P-1 | 7,500 | .055 | .000 | 15,000 | .117 | .001 | 20,000 | .159 | .005 | 27,400 | 339.5 | 1590.0 |
| 13 | Vanderbilt ....... | Solid | 105.00 | D-1 | 7,500 | .064 | .000 | 15,000 | .128 | .002 | 18,000 | .160 | .005 | 23,000 | 219.0 | 1440.0 |
| 10 | Buffalo .......... | Solid | 110.00 | M-1 | 7,500 | .048 | .000 | 15,000 | .105 | .000 | 20,000 | .147 | .000 | 22,850 | 253.1 | 1470.0 |
| 14 | Waycott ......... | Truss | 94.50 | L-2 | 7,500 | .063 | .012 | 15,000 | .137 | .033 | Inde | finite. | | 29,950 | 317.0 | ......... |
| 16 | National Hollow .. | Truss | 69.00 | J-1 | 7,500 | .082 | .000 | 15,000 | .174 | .023 | Inde | finite. | | 25,200 | 365.2 | ......... |
| 19 | National Hollow .. | Truss | 74.00 | Extra | 7,500 | .070 | .004 | 15,000 | .202 | .066 | 10,000 | .097 | .010 | 18,325 | 247.6 | 485.0 |
| 21 | Atlas............ | Truss | 127.00 | None | 7,500 | .064 | .008 | 15,000 | .115 | .020 | Inde | finite. | | 51,400 | 404.7 | ......... |
| 11 | Marden .......... | Solid | 91.00 | Q-1 | 7,500 | .110 | .000 | 15,000 | .214 | .003 | 14,000 | .200 | .000 | 17,000 | 186.8 | 1400.0 |
| 22 | Keystone ........ | Truss | 115.00 | None | 7,500 | .038 | .001 | 15,000 | .081 | .011 | Inde | finite. | | 62,600 | 544.3 | ......... |
| 20 | Haskell & Barker . | Truss | 65.00 | K-2 | 7,500 | .100 | .008 | 15,000 | .267 | .115 | Inde | finite. | | 20,160 | 310.1 | ......... |
| 24 | ? ........ | Solid | 105.00 | None | 7,500 | .083 | .000 | 15,000 | .160 | .004 | 16,000 | .180 | .005 | 20,500 | 195.2 | 1440.0 |
| 42 | Creco. .......... | Truss | 68.5 | None | 7,500 | .070 | .005 | 15,000 | .139 | .009 | 22,500 | .211 | .015 | 28,300 | 413.1 | 2373.8 |
| 43 | Creco. .......... | Truss | 86.0 | None | 7,500 | .043 | .002 | 15,000 | .089 | .003 | 28,000 | .187 | .009 | 38,050 | 442.4 | 2618.0 |
| 44 | Creco. .......... | Truss | 91.5 | None | 7,500 | .040 | .000 | 15,000 | .078 | .003 | 18,000 | 090 | .003 | 41,645 | 455.1 | 810.0 |
| 48 | Pressed Steel..... | Truss | 94.5 | None | 7,500 | .048 | .000 | 15,000 | .110 | .007 | 14,000 | .100 | .005 | 28,500 | 301.5 | 700.0 |

## TRANSVERSE TEST.

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | Simplex ......... | Solid | 96.50 | Extra | 1,500 | .459 | .031 | 3,000 | 1.275 | .420 | 2,000 | .620 | .070 | 3,800 | 39.4 | 620.0 |
| 3 | Simplex.......... | Solid | 94.50 | C-1 | 1,500 | .534 | .017 | 3,000 | 1.263 | .260 | 2,000 | .712 | .051 | 6 250 | 66.1 | 712.0 |
| 28 | Simplex.......... | Solid | 124.00 | F-1 | 1,500 | .205 | .008 | 3,000 | .420 | .030 | 4,000 | .580 | .060 | 6,660 | 53.7 | 1160.0 |
| 36 | Simplex.......... | Truss | 138.50 | G-2 | 1,500 | .195 | .027 | 3,000 | .415 | .065 | Inde | finite. | | 9,400 | 67.8 | ......... |
| 40 | Simplex.......... | Truss | 131.50 | H-2 | 1,500 | .343 | .113 | 3,000 | .656 | .223 | Inde | finite. | | 8,975 | 68.2 | ......... |
| 33 | Pressed Steel ..... | Solid | 94.75 | A-2 | 1,500 | .757 | .062 | 3,000 | 2.050 | .550 | 1,400 | .690 | .050 | 5,000 | 52.8 | 483.0 |
| 26 | Monarch ......... | Solid | 80.50 | S-2 | 1,500 | .645 | .051 | 3,000 | 2.475 | 1.040 | 1,400 | .590 | .033 | 4,200 | 52.2 | 413.0 |
| 25 | Sterlingworth. .... | Solid | 85.50 | R-2 | 1,500 | .785 | .150 | 3,000 | 2.110 | .740 | 1,200 | .610 | .040 | 4,435 | 51.9 | 366.0 |
| 34 | Central .......... | Solid | 80.75 | P-2 | 1,500 | .435 | .032 | 3,000 | .930 | .120 | 3,000 | .930 | .120 | 4,350 | 53.8 | 1395.0 |
| 38 | Vanderbilt ....... | Solid | 103.00 | D-2 | 1,500 | .370 | .080 | 3,000 | .740 | .080 | 3,000 | .740 | .080 | 8,400 | 81.5 | 1110.0 |
| 29 | Buffalo ........ | Solid | 108.50 | M-2 | 1,500 | .301 | .017 | 3,000 | .621 | .058 | 3,000 | .621 | .058 | 8,400 | 73.7 | 931.5 |
| 35 | Waycott ......... | Truss | 95.00 | L-1 | 1,500 | .452 | .040 | 3,000 | 1.050 | .260 | Inde | finite. | | 4,955 | 52.1 | ......... |
| 31 | National Hollow... | Truss | 69.00 | J-2 | 1,500 | .852 | .325 | 3,000 | .......... | ...... | 800 | .250 | .025 | 2,590 | 37.5 | 100.0 |
| 9 | Atlas............ | Truss | 127.00 | None | 1,500 | .542 | .045 | 3,000 | 1.095 | .170 | 2,800 | .980 | .140 | 5,530 | 43.5 | 1372.0 |
| 30 | Marden .......... | Solid | 94.50 | Q-2 | 1,500 | .602 | .011 | 3,000 | 2.410 | 1.380 | 1,800 | .730 | .025 | 3,225 | 34.1 | 657.0 |
| 39 | Keystone ........ | Truss | 115.00 | None | 1,500 | .464 | .041 | 3,000 | .879 | .234 | 2,000 | .590 | .076 | 5,380 | 46.7 | 590.0 |
| 32 | Haskell & Barker. . | Truss | 66.50 | K-1 | 1,500 | 2.007 | 1.115 | 3,000 | .......... | ...... | Inde | finite. | | 2,700 | 40.6 | ........ |
| 37 | ? ........ | Solid | 105.00 | None | 1,500 | .352 | .018 | 3,000 | .800 | .140 | 2,200 | .520 | 040 | 5,470 | 52.1 | 572.0 |
| 45 | Creco. .......... | Truss | 68.0 | None | 1,500 | 1.733 | .154 | 3,000 | 3.935 | 1.010 | Inde | finite. | | 3,220 | 47.3 | ......... |
| 46 | Creco. .......... | Truss | 86.0 | None | 1,500 | 1.237 | .280 | 3,000 | 2.569 | .645 | Inde | finite. | | 4,240 | 49.3 | ......... |
| 47 | Creco. .......... | Truss | 92.0 | None | 1,500 | .880 | .272 | 3,000 | 2.105 | .475 | Inde | finite. | | 5,550 | 60.3 | ......... |
| 49 | Pressed Steel ..... | Truss | 95.0 | None | 1,500 | .597 | .053 | 3,000 | 1.514 | .485 | Inde | finite. | | 4,140 | 43.5 | ......... |

**Table 2—Summarized Data of Brake Beam Tests.**

meet these specifications, if adopted as standard, some provision should be made for testing the beams. Very few, if any, of the railroads now have the proper facilities for doing this work. It would seem desirable for testing machine builders to design a machine for the special purpose of testing brake beams, and either requiring that the manufacturers purchase such a machine for the purpose of making tests when called upon by the purchaser, or that the association purchase such a machine and locate it at some convenient point, so that it can be used by the railroads and the members of the association.

The committee accordingly recommends for adoption as standard, two brake beams, which shall be known as beam No. 1, for use under cars having a light weight of 30,000 lbs. or less, and beam No. 2, which shall be used under cars having a light weight in excess of 30,000 lbs. Both beams shall conform to the following specifications:

*Specifications.*—1. All beams shall be 60¼ in. in length from center to center of brake head, with an allowable variation of ⅛ in. in each direction, and shall be proven by the gage shown by Fig. 3, applied to the center and each end of the brake heads, which shall be the standard gage for this purpose.

2. All brake heads shall conform to the M. C. B. standard dimensions, and shall be proven by the gage shown by Fig. 5, which shall be the standard gage for this purpose.

3. Attachments for safety hangers shall be 51 in. from center to center.

4. The angle of the lever fulcrum shall be 40 deg. from the vertical.

5. The lever pinhole shall be 3 in. in front of the top of the brake head lugs. The variation in either direction shall not exceed $^1/_{16}$ in.

6. The lever pinhole shall not be less than $1^3/_{32}$ in. in diameter, nor more than $1^5/_{32}$ in. in diameter, and shall be proven by the gage shown by Fig. 6, which shall be the standard gage for this purpose.

7. The maximum distance from the lever pinhole to the extreme back of brake beam should not exceed 9½ in.

*Test.*—8. For each 500 brake beams, or less, which pass inspection and are ready for shipment, one representative beam shall be taken at random, and subjected by the company manufacturing the beams, and in the presence of the railroad company's inspector, to the following test in a suitable machine:

The beams shall be equipped with suitable heads and shoes, and the shoes placed in contact with castings representing the tread of the wheel; when mounted in this manner, the load shall be applied to the fulcrum in the normal line of pull. As a preliminary to the test a load of 6,000 lbs. shall be applied and released, after which observations for records shall be taken. Beam No. 1, under a load of 7,500 lbs., shall not deflect to exceed .0625 in., beam No. 2, under a load of 15,000 lbs., shall not deflect to exceed .0625 in.

9. In case a beam shall fail in this test, then a second beam shall be taken from the same lot and similarly tested. If the second beam stands the test, it shall be optional with the inspector whether he shall test a third beam or not. If he does not do so, or if he does, and the third beam stands the test, the 500 beams, or less, shall be accepted as filling the requirements of this test.

10. Individual beams will not be accepted which (1) do not conform to standard dimensions, and (2) those that have physical defects. Any lot of 500 beams, or less, submitted for test, that fail to meet the prescribed test (Pa. 8) will not be accepted.

The committee further recommends for adoption by the M. C. B. Association as recommended practice:

1. That all beams be inside hung.
2. That all beams be hung 13 in. from the rail.
3. That brake hangers shall be attached to the brake head at the center, and just back of the central brake shoe lug.
4. That brake hangers shall be ⅞ in. in diameter.
5. That brake hangers should have an angle as nearly as possible to 90 deg. from a line drawn from the center of the brake shoe to the center of the axle, when the shoes are half worn.
6. Third suspension hangers should be used on all brake beams. They should be attached to flexible brackets, and should have the same angle and length as the brake hangers.
7. For safety hangers, chains should be used.
8. That, in order that these specifications may be generally observed, after September 1, 1910, all cars not equipped with brake beams built in accordance with these specifications, be subject to rejection in interchange on account of improper equipment.

The tests of brake beams made during the year at Purdue University for the committee were of two kinds: The direct test* and the transverse test.

*Direct Test.*

In the direct test, the load was applied at the lever fulcrum in the direction of the plane of the brake beam and at right angles to a line joining the brake shoes. Shoes were inserted in the shoe holders, and the beam along with the shoes was supported on castings, which represented a segment of the circumference of a car wheel. These castings constituted a convenient method of supporting the beam. The plane of the beam was adjusted to the vertical in the testing machine, and the line of pull was in the axis of the testing machine. The span was defined to be 5 ft. 0½ in. by knife edges upon which these castings rested.

Loads were applied to the beam, thus supported, in increments through the lever fulcrum, and each load was released after having been applied. A 30,000-lb. Olsen testing machine was used for the lighter beams, and a 100,000-lb. Olsen testing machine for the heavier beams.

The deflection of the beam under each loading, and the set after each loading, were observed by a special deflectometer.

*Transverse Test.*

The shoes were attached to the holders and bolted to a special casting. These castings rested on knife edges, which fixed the span of the beam as 5 ft. 0½ in., and disposed the plane of the brake beam at right angles to the direction of the loading. The plane of the beam was horizontal in the testing machine, and the loads were applied in the direction of the axis of the machine. Loads were applied transversely, or at right angles to the plane of the brake beam, through the lever pinholes. Loads were applied in increments, and each load was released after having been applied.

*Results of Tests.*

The main results of the tests are presented in Table II, which gives the Laboratory or Test number, the name of the beam, its weight, mark, etc. The stiffness is shown by the amount of deflection. The strength is given in pounds of load.

The strength of the beam per unit of its weight is also quoted, and the resilience.

*Conclusions.*

The following conclusions may be drawn:

UNDER THE DIRECT TEST:

(1) The truss beams are stronger than the solid beams, both absolutely and per unit of their weight.

(2) The truss beams are stiffer than the solid beams.

UNDER THE TRANSVERSE TEST:

(3) The solid beams are stronger than the truss beams.

(4) The solid beams are stiffer than the truss beams.

IN GENERAL:

Under the direct test the primary cause of failure is the yielding of some part of the beam (the truss rod, or else the compression member, of truss beam, or the compression flange of a solid beam) under the direct action of the load. Subsequently the beam buckles sidewise. It appears that the beams tested are sufficiently stiff in the transverse direction to develop their strength under direct loading.

(7) Inasmuch as transverse stiffness and strength are necessary in order to develop the direct strength of the beams, it would seem that the proper specifications for strength under direct loading will insure strength under the transverse loading.

The report is signed by A. E. Mitchell, R. B. Kendig, W. E. Sharp, W. F. M. Goss, G. W. Wildin.

### TRIPLE VALVE TESTS.

During the past year a triple valve containing new features has been placed on the market by the Westinghonse Air Brake Company, and this valve in two sizes was submitted to the committee for test.

This valve, which is designed for freight equipment, contains three principal features not found in valves previously tested for the Master Car Builders' Association. They are as follows:

First, a quick service application.

Second, a retarded release.

Third, a retarded recharge.

The two sizes of this valve are designated as K-1 for 8-inch cylinders and K-2 for 10-inch cylinders.

The Westinghouse Air Brake Company has, for some time, furnished a triple valve designated as H-49 for 10-inch brake cylinders. This valve is similar in design to the F-36 valve, and only differs from the latter in the capacity of handling larger volumes of air. No previous tests of the H-49 valve have been made by an M. C. B. committee.

The committee expected that an entirely new type of triple would be submitted for test on the Purdue rack and arrangements were completed for making these tests. However, at the last moment the manufacturers withdrew from the test, intimating that a test of 50 cars was not satisfactory, and stating that if the M. C. B. requirements were changed from 50 to 80, 90 or even 100 cars, they would be glad to turn their valve over to the committee for test. This communication was received too late for the committee to make arrangements for conducting the test on a 100-car rack.

The committee fully appreciates the fact that a 50-car test as provided for in the M. C. B. code does not develop the conditions that must be met in handling trains of 80 or more cars.

The Westinghouse Air Brake Company, in offering its new type of triple for test, stated that these valves would materially improve

*Sometimes called the pulling test.

the operation of brakes on trains of 50 cars or less, and were especially designed to meet the conditions which develop in handling trains of 80 or more cars. This company also stated that there was little to be gained by making a 50-car test, and that they would prefer making a test of 75 or 100 cars. The committee advised the Westinghouse Air Brake Company that the testing rack at Purdue could not be used for more than a 50-car test. The Westinghouse Air Brake Company then offered the committee the use of either one or both of its 100-car test racks at Wilmerding. This offer was accepted with the understanding that the committee should have the exclusive use of the rooms, with the privilege of using either rack for testing triple valves manufactured by other companies.

The committee arranged to make test on April 5, 6 and 7, 1906, and invited the Air Brake Association to appoint a committee to assist in making tests.

All application tests were made with an 8-in. piston travel, while the code specifies 4, 6 and 12 in. piston travel. The committee found that an 8-in. piston travel more nearly approximated actual conditions in road service, and therefore felt justified in making tests under road conditions.

The G-6 brake valve was used throughout the tests.

The report has two appendices, one giving a full explanation of the new Westinghouse type "K" triple valve and the other the complete report of the tests made. This valve was described in the *Railroad Gazette* March 23, 1906. The following is a brief summary of the results of the tests:

*Service Application Tests.*—This test demonstrated that the K-2 triple valve prevents the back flow of air from the auxiliary reservoirs to the drain pipe, and leakage from the brake cylinder to the atmosphere through the leakage groove which is common to standard triples, thereby insuring maximum equalized pressure in all cylinders in trains of 100 cars or less.

*Time of Emergency Application.*—The time required to obtain 45 lbs. and 55 lbs. in the brake cylinder was slightly longer than the time specified in the code, this applying to both the H-49 and K-2 types of triples. This can be accounted for as a result of the test being made with an 8-in. piston travel, also with the H-49 to the increased size of feed groove.

*Application Test—Emergency.*—This test, known as the jumping test, was made with H-49 and K-2 valves on 50-car and 100-car trains. The valves jumped all right, but for the reason given in the test above, they failed slightly in the 55 lbs. time requirement on the 50th car.

*Graduating Test, 50-Car Train.*—The valves met the requirements of this test. It was not found necessary to make 30 lbs. reduction.

*Sensitiveness of the Valve—Service and Emergency Disc Tests.*—All the valves applied in service application within the code limits. Four of the valves applied partial emergency with a 10-64-in. disc opening. This action should not have taken place with less than an 11-64-in. disc opening, this showing that some of these valves are more sensitive to emergency applications than is provided for in the code.

*Holding Power of the Brake.*—The committee did not make this test with the valves.

*Release Test.*—While this has always been regarded as the most severe test in the code, the results were very satisfactory. While none of the brakes released before the expiration of five minutes, 14 released between five and 10 minutes, 22 between 10 and 15 minutes, 13 between 15 and 20 minutes, and the last in 21 minutes and 9 seconds.

*Time of Charging Auxiliary Reservoirs.*—This test showed the retarded recharge of reservoirs which would take place at the forward end of a train, and which results in a more uniform recharging of the auxiliary reservoirs in a long train.

*Service Application Followed by Emergency.*—The valves met the requirements. The tests demonstrated that quick action will follow service application as called for in the code.

In addition to these standard tests the committee made four other tests as follows:

*Application Tests.*—(a) Comparative tests to show the number of brakes applied with a H-49 and K-2 valves with varying train-line reductions.

With a 3-lb. train-line reduction the H-49 failed to apply any brake, while with the same train-pipe reduction (3 lbs.) the K-2 applied 98 of the 100 brakes, and the K-1 applied all of the 100 brakes. With a 5-lb. reduction the H-49 valve applied but 29 brakes out of 100, while with the same train-pipe reduction (5 lbs.) the K-2 triple valve applied 100 brakes. This superiority in the performance of the K type triples is the result of the "quick service" feature. The quick service feature of the K triple results in a much shorter train-pipe exhaust at the brake valve for a given reduction.

(b) Comparative tests to show the rapidity of application with service reductions in train line pressure.

A careful study of records of this test showed a marked superiority of the K type as compared to the H-49 triple and the rapidity of service application of the K type throughout the train. Particular attention is called to one test in which an interval in time of 56⅘ seconds was shown between brake application on the first and last cars of a 100-car train with the H-49 triples, while the K triple showed but 16 seconds interval. This will go far in preventing shocks when service applications are made.

(c) Time of graduations. This test, supplementing (b), further demonstrated the difference between types H-49 and K triples as regards time of obtaining 10, 25 and 45 lbs. pressure in brake cylinders. The type K valves gave uniformly quicker results in this respect.

(d) Release test, time required for piston to move back in cylinder.

These tests plainly showed the retarded release feature of the K type of triple valve. In every test of the K type of valve, except one, the rear brakes released first. This feature should prove an important factor in preventing break-in-twos on long trains.

The committee is of the opinion that a new code of tests for trains of 75 or 100 cars should be compiled. It would also recommend that the testing rack at Purdue University be redesigned to allow of testing as many as 100 brakes of either 8-in. or 10-in. equipment.

The report is signed by A. J. Cota, T. W. Demarest, E. W. Pratt, F. H. Scheffer, F. W. Brazier.

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### BRAKE SHOES.

To the President and members of the Master Car Builders' Association:

Gentlemen—The committee on brake shoes, at a meeting held at Indianapolis Oct. 10, 1905, agreed that some inquiry should be made to ascertain the frictional quality of the shoes now being supplied to railway companies in comparison with the specifications of the Association. A circular was issued, requesting the railroad companies to submit shoes for tests, shoes submitted to be taken from service after having been approximately one-third worn. It was requested also that all shipments be made prior to January 1, and it was announced that in case a considerable number of shoes were received, to keep the research within manageable limits the committee would reserve the right to select from the whole number received such shoes for test as seemed to be most representative of the whole collection.

Under this arrangement a total of 100 shoes were received from nine different railroad companies; two of the shipments, however, arriving too late to receive attention during the present year. As the shipments came in, each shoe was assigned a laboratory number, the first having been given No. 151 and the last No. 251.

All shoes received were delivered to the Engineering Laboratory of Purdue University, where they will be held for future reference or for further tests. The tests were made under the direction of the university, the work being in the immediate charge of Prof. W. O. Teague.

It had been requested that each shoe be marked with a statement of the service from which it had been taken. In cases where the accompanying statement showed that the shoe had been taken from freight service, it was tested upon a cast-iron wheel only; where the statement showed that it had been taken from passenger service it was tested on a steel-tired wheel only, and where no statement as to service accompanied the shoe it was tested on both cast-iron and steel-tired wheels.

The results disclosed the fact that of the 15 shoes tested on the cast-iron wheel, three (Nos. 179, 183 and 209) completely met the specifications of the Association. Eleven of the 15 (Nos. 158, 172, 175, 179, 183, 186, 194, 200, 205, 209 and 220) met the specifications as to the mean coefficient of friction, but eight of this number exceeded the limits allowed at the end of the stop. Five shoes (Nos. 161, 178, 179, 183 and 209) met the specifications as to the rise in the coefficient at the end of the stop. Of the nine shoes tested on the steel-tired wheel, all met the specifications as to the mean coefficient of friction during a stop, but all failed to meet the specifications as to rise in the coefficient of friction at the end of the stop.

The committee would call attention to the fact that while the specifications provide for a minimum coefficient of friction they do not fix a maximum; also to the fact that at least two shoes which were tested possess frictional qualities which are far in excess of the minimum values specified. While a high coefficient of friction is, in the abstract, a desirable characteristic to be possessed by a brake shoe, operating conditions make uniformity of action desirable. For example, the records of the Association show that a large amount of attention has been bestowed upon the triple valve for the purpose of securing uniformity both in time and intensity of its action, that the surging of trains may be prevented. But the retarding force which is set up through the action of the brakes is as much a function of the frictional qualities of the brake shoe as of the action of the triple valve. Assuming all cars of a train to have the same brake leverage and to be equipped with triple valves possessing identical characteristics, if the frictional qualities of the brake-shoe are disregarded, that car which is fitted with shoes developing a high coefficient will tend to stop more quickly than an

adjoining car having brake shoes possessing inferior frictional qualities. If variations in the coefficient of friction of brake shoes are allowed to become great, the surging of the several cars making up the train is likely to become severe. A brief summary of the tests is as follows:

*Mean Coefficient of Friction Developed upon a Cast-Iron Wheel under a Brake-shoe Pressure of 4,152 Lbs.*

| | Coefficient | | | Coefficient | |
|---|---|---|---|---|---|
| Brake-shoe No. | Of friction. | Of friction at point 15 ft. from stop. | Brake-shoe No. | Of friction. | Of friction at point 15 ft. from stop. |
| Values provided | | | 179 | 33.2 | 6.3 |
| for by specifications...... | 20.0 | 7.0 | 183 | 37.4 | 2.6 |
| | | | 186 | 21.3 | 8.6 |
| 158 | 20.0 | 5.2 | 194 | 22.3 | 7.6 |
| 161 | 21.6 | 2.2 | 200 | 20.3 | 6.9 |
| 163 | 21.3 | 7.0 | 205 | 21.4 | 7.7 |
| 172 | 20.6 | 6.9 | 209 | 23.8 | 5.5 |
| 175 | 27.2 | 7.0 | 214 | 19.3 | 6.7 |
| 178 | 17.7 | 6.4 | 220 | 24.4 | 7.0 |

*Mean Coefficient of Friction Developed upon a Steel-Tired Wheel under a Brake-shoe Pressure of 4,152 Lbs.*

| | Coefficient | | | Coefficient | |
|---|---|---|---|---|---|
| Brake-shoe No. | Of friction. | Of friction at point 15 ft. from stop. | Brake-shoe No. | Of friction. | Of friction at point 15 ft. from stop. |
| Values provided | | | 175 | 18.4 | 12.4 |
| for by specifications...... | 14.0 | 7.0 | 178 | 16.7 | 9.2 |
| | | | 179 | 22.8 | 7.8 |
| 158 | 17.0 | 9.0 | 205 | 16.3 | 8.9 |
| 161 | 14.8 | 10.1 | 209 | 16.0 | 11.1 |
| 163 | 18.9 | 8.8 | 215 | 16.5 | 10.8 |

Thus far the standing committee on brake-shoes has concerned itself with the frictional qualities of brake-shoes. The question has often been raised as to whether it would not be practicable for the committee to test the wearing qualities of brake-shoes. Response to inquiries of this kind has uniformly been made to the effect that the processes of the laboratory proceed too slowly to permit such tests to be made, and those inquiring have been referred to road tests as the readiest means of determining the endurance of shoes. The committee is, however, convinced that many interests would be served if manufacturers, in submitting shoes for tests, could be given a statement covering wearing qualities, as well as a statement covering coefficient of friction. It is also possible that if a satisfactory test could be formulated, specifications covering wearing qualities might be framed.

In its consideration of this matter, the committee has reached the conclusion that such tests are possible provided some additional mechanism could be attached to the testing machine. The purpose of the proposed addition to the testing machine would be to permit a shoe to be brought in contact with the wheel of the testing machine for a predetermined interval, after which it would be automatically raised from the wheel and remain in released position for another and a much longer interval, after which it would again automatically make contact with the wheel. It is believed that by such a cycle, any shoe could be given a definite amount of exposure to wear and that by the automatic action of the machine in alternately making the application and release, all chances of excessive heating would be avoided.

Mr. Fritz Ernest, instructor in Car and Locomotive Design, Purdue University, undertook a study of the problem with the result that the details of a satisfactory mechanism have been designed. The cost of making the proposed additions will be between \$300 and \$400.

In conclusion, to summarize its report, the committee would call attention to the following matters:

1. That shoes taken from service have in most cases met the requirements of the Association with reference to the mean coefficient of friction to be developed during a stop.

2. That shoes taken from service have in most cases failed to meet the requirements of the Association with reference to the rise in the coefficient of friction at a point 15 ft. from the end of the stop.

3. That shoes are now in service which give a coefficient of friction so much in excess of the minimum specified as to permit great variation in braking effect. The logic of the situation would seem to require, either that the present specification be raised, or that a maximum coefficient as well as a minimum be specified.

4. That it would be well to equip the Association's testing machine for determining the wearing qualities as well as the frictional qualities of brake-shoes, and to this end we would recommend that the question of proceeding with the construction of such equipment be referred to the Executive Committee.

The report is signed by W. F. M. Goss, Wm. Garstang, Geo. W. West.

REVISION OF STANDARDS AND RECOMMENDED PRACTICE.

The committee has few changes to suggest. It recommends the appointment of special committees to investigate and report on changing standard height of couplers and the design of passenger car journal box and pedestal for journals 4¼ in. x 8 in. and 5 in. x 9 in.; changing the wording of part of the Standards referring to protection of trainmen to conform to the drawings and striking out from among the miscellaneous paragraphs that one relating to the storage of private line cars. The report is signed by C. A. Schroyer, T. S. Lloyd and M. Dunn.

## Cracked and Leaky Mud Rings.

At the recent convention of International Railway Master Boiler Makers the subject of cracked and leaky mud rings was one of the principal topics discussed. In the three brief papers presented on the subject it was agreed that the corner is the place where trouble develops. As a general thing, in the case of light single-riveted rings the crack will start at the top of the inside corner and work down and through it along the line of stress. Where the rings are double riveted the crack will start on the end close to the corner at the bottom and run up to a rivet hole, and there stop. It would appear that the failure in the case of the light ring is due to the stresses set up by variations in expansion, while those in the heavy ring are caused by the pounding of the ring on the frame or its supports.

A crack of this kind can be repaired by applying a copper patch to the bottom of the ring over the crack, first taking care to chip the face of the ring down flush with the edges of the sheets. The patch itself should be put on with patch bolts, and allowed to lap over the bottom edges of the sheets. Where the crack extends all the way through the ring, however, it will hardly be worth while to attempt to patch it, as the stresses will be the same as those that caused the original failure, and there will be a second one and leakage. Hence patching under these conditions is only a temporary expedient. The only real remedy is to remove the ring and weld the corner. A patch will sometimes hold, however, when the crack merely extends up into the rivet hole.

As prevention is better than cure or mending, it is well to take pains with the designing of the ring. The aim should be to get a corner that will resist the great stresses to which it may sometimes be subjected. For this purpose the corners of light rings may be raised. Thus something will be added to the strength. Sharp angles or short radii on the inside should be avoided, as more likely to cause a crack to start than where the curve is easier. A radius of at least 2½ in. should be used at this point, and the surface milled so that the sheet may come down smooth and tight against the ring. It is also well to have the corners extended with a flange ¾ in. thick forged on the inside, so that the inside sheets may have three additional rivets. When a mud ring has been made and applied along these lines, and the sheets have a bearing for the full depth, and the calking and riveting has been well done mechanically, it is difficult to see how it can be improved.

The fact that good work is to be done on the sheets must not be lost sight of, for much depends upon proper laying, if leaky corners are to be avoided. For this it is well to heat them to a flanging temperature after the firebox has been put together and the mending is in position. In doing this a fuller of the proper size to suit the radius of the corners of the mud ring should be selected so that the sheet may be set back tight, for there is no advantage in using a 4-in. mud ring and having the sheet in contact with it for only half its width. The benefit of the full width of ring should always be obtained. In order, too, that the sheet may be made to lie close to the ring it should be fullered 3 in. or 4 in. above the top of the latter, depending on the distance that it stands off when first applied. This is an important matter, and if the suggestion is followed it will avoid a sharp offset in the sheet at the top of the ring, besides keeping the sheet snugly in position at this point. Cases are known where this has not been done, and the sheets stood off as much as ¼ in. at the top, although the calking edge was tight.

A very good method of laying up firebox sheets, especially when renewing them, is to use sufficient material so as to have a long scarf on the side sheet, which will extend around the inside corners when the ring is in place. This may then be raised to a red heat by an oil burner, and the metal set up solidly against the ring with a fuller. The holes should be counterbored and the rivets driven on the inside. When fireboxes are fitted in this way they will be satisfactory. The top of the ring should also receive attention by being rounded off on the edge and not left with a sharp corner, which is apt to cut into and injure the sheet.

These may all seem to be trifling matters in themselves, but probably 75 per cent. of the leaky mud rings are due to an improper laying up of the sheets. The best method of remedying leaking will frequently be found to be to remove the rivets at the corner, close the sheets up tight against the ring, and redrive the rivets. This should invariably be done if the ring still continues to leak after it has been well calked. Continued calking is of little use. Cases have even been observed where the metal has been entirely cut away without stopping the trouble. Cast steel mud rings are being introduced, and are working well as a whole. They are giving no trouble from breakage, but they should be most carefully inspected before using, as they are apt to be honeycombed with blowholes that will cause leakage.

The North China Railroad from Pekin's port, Tientsin northeastward into Manchuria, parallel with the Chinese Eastern Railroad (late Russian), is to be extended by the Japanese about 40 miles to Fa-Ku-Men, where it will be about 30 miles west of the

Chinese Eastern. This new line will be near to and parallel with the borders of the province which is under the protectorate of Japan, and will make it easier to defend. The country through which it extends is very productive, especially in Sorghum (the bread of the country) beans (of which 20,000,000 bushels have been exported in one year from the Manchurian port New-Chwang) and hogs, and ought to support a railroad.

### Handling Engines at the Ashpit.

In the paper presented to the International Railway Master Boiler Makers' Convention on this subject by Mr. Batchman, of the Lake Shore & Michigan Southern, a point was made of the necessity for care in the use of feed water. If the water is low it should be replenished before the engine is taken to the ashpit. The engine should be kept in motion as much as possible while the injector is at work. A large percentage of failures due to leaky flues and fireboxes has been traced to the improper handling of engines at terminals and on the ashpit. Feeding water while standing on sidings or over the ashpit will cause tubes to leak nine times out of ten. For that reason the engine should be kept in motion, which causes the water to circulate and prevents it from going to the bottom. Engines will frequently come in from a run of 135 miles or more and be in first-class condition, with not a leak to be found, and then in an hour will be in the roundhouse with half the tubes leaking simply because improperly handled over the pits. The engine should be brought to the pit with the boiler filled. The fire may then be knocked out, dampers closed, front end cleaned and the machine taken to the roundhouse. When there is no work to be done, the fire should simply be cleaned and banked. When washing is to be done, steam should be blown off and the boiler cooled through the check or injector pipe, with the blow-off cock open. But in no case should the water be allowed to drop below the crown-sheet until the bare hand can rest upon the boiler head. In doing this work, all plugs should be removed and the crown-sheet washed first; then the arch tubes and the space above the fire door, after which the barrel, where good results can be obtained by having at least two tube-pockets in the back tube-sheet, which should be removed every month or so for washing the barrel and throat-sheet.

### Exhibits at the Atlantic City Convention.

The large and small exhibits at Atlantic City are located on the Steel Pier, with the exception of the large Niles-Bement-Pond driving wheel lathe, for which a special booth has been erected within 10 minutes walk of the pier, and the track exhibits which are located on the side tracks at the Pennsylvania station. The exhibits this year, both in number as well as in the total floor space occupied, greatly exceed any previous year's exhibits at these conventions. A comparison of the present Atlantic City exhibit and of the exhibit held at Manhattan Beach last year is of interest. Last year the official figures show that there were 208 exhibitors, occupying a total floor space of 38,123 sq. ft., whereas this year the number of exhibitors is 254, covering a total floor space of 66,350 sq. ft. The following is a partial list of the exhibits. The remainder will be printed in another list next week.

Adams & Westlake Co., Chicago.—Adlake acetylene gas car lighting system; railroad lanterns; non-sweating, down-draft signal lamps; car hardware; and gas and electric chandeliers. This company also has an exhibit truck, consisting of a demonstration of the Newbold system of electric car lighting from the axle.

American Balanced Valve Co., Jersey Shore, Pa.—Various types of semi-plug and high-pressure valves, including external admission, reversible, double-end and triple-end semi-plug piston valves, also a semi-plug piston valve for passing over ports without bridges, and an American plug piston valve after 2 years and 9 months service; Jack Wilson high pressure double-acting valves, internal admission, for low cylinder clearance and external admission three-ring type; Jack Wilson slide valve as used on Philadelphia & Reading Atlantic City fast locomotives, and a model of the Walschaert valve motion as used on the Pennsylvania Atlantic type locomotives.

American Brake Shoe & Foundry Co., Mahwah, N. J.—Showing the reinforced brake shoe for modern railway service, both steam and electric.

American Car & Foundry Co., New York.—All-steel electric motor car built at the Berwick Works for the N. Y. Central New York City suburban service. Equipped with Sprague G. E. multiple-unit control and 2 G. E.-69 200-h.p. motors and American Locomotive Co.'s electric trucks.

American Locomotive Company, New York.—Baltimore & Ohio consolidated locomotive, fitted with Walschaert valve gear. Erie Pacific type passenger locomotive, electric motor truck for N. Y. C. & H. R. R. R. suburban service; also a trailer truck; and a joint exhibit with the General Electric Co. of the N. Y. C. & H. R. R. R. electric locomotive.

American Lux Light Co., Dunkirk, N. Y.—The Lux arc light for vaporizing and burning ordinary kerosene oil on an incandescent mantel as gas. This light is so graduated as to furnish any candle power desired, ranging from 200 c.p. to 1,200 c.p. in one and the same lamp.

American Mason Safety Tread Co., Boston, Mass.—Lead and carborundum safety treads for car steps, stations, etc.

American Steam Gauge & Valve Mfg. Co., Boston, Mass.—Locomotive steam specialties, such as open and muffled pops, steam gages, blow-off valves, globe and angle valves, chime whistles, air-brake records, etc.

American Steel Foundries, Chicago.—Cast-steel locomotive frames; cast-steel driving wheel centers; Simplex brake-beam; Simplex driving wheel and coach springs; Simplex car and tender bolsters; cast-steel bolsters; cast-steel side rods and crossheads; Janney cast-steel coupler; the Davis cast-steel car wheel; Susemihl roller-side bearings; Andrews cast-steel side frame; and spring controllers.

American Vibrator Co., New York and St. Louis.—Electric vibratory massage motors.

Armstrong Brothers Tool Co., Chicago.—Various designs of tool holders for all purposes.

Baeder, Adamson & Co., Philadelphia, Pa.—Large model of refrigerator car, showing hair-felt insulation.

W. C. Baker Heating & Supply Co., New York.—Baker car heaters and steam attachments.

Barnett Equipment Co., Newark, N. J.—Demonstration of the Barnett Connector automatically coupling the steam heat, signal and air-brake service and safety hooks (in lieu of safety chains) between cars.

Besly, Chas. H., & Co., Chicago.—Spiral-grooved steel grinding disks; heavy spiral cloth and paper circles; Helmet temper taps for threading nuts; Helmet-Babbit for bearings, Helmet oil and Helmet grease cups.

Bettendorf Axle Co., Davenport, Ia.—Bettendorf passenger, freight and tender trucks; passenger I-beam truck frame; removable journal box truck frame and riveted arch bar truck frames.

Bleibtrey, John E., Waterford, N. Y.—McAndrews locomotive rod-key.

Bordo, L. J., Co., Philadelphia, Pa.—Blow-off valves, hydraulic valves and swing joints for locomotive and tender connections.

Bowser, S. F., & Co., Fort Wayne, Ind.—Oil house equipment for railroads and factories; also shop tanks, cabinets, etc.

Boyd, Jas., & Bro., Philadelphia, Pa.—Complete fire fighting equipments for shops, including the "Keystone" fire extinguishers, "Boyd's Champion" chemical engine, 1,250 ft. of 1-in. "Electric" hose made in one piece; also air, steam heat and signal hose.

Brady Brass Co., Jersey City, N. J.—Cyprus bronze locomotive castings and bearings; Cyprus bronze journal bearings; motor bearings for electric railways; babbit metal solder; battery zincs and phosphor bronze.

Buckeye Steel Castings Co., Columbus, Ohio.—Major coupler for freight cars; Ohio passenger coupler and a number of old Major freight car couplers which have been in service for 2 years and more; also the Buckeye cast-steel yoke, adapted for any and all kinds of draft gears.

Butler Draw-bar Attachment Co., Cleveland, Ohio.—Butler draw-bar attachments.

Cardwell Mfg. Co., Chicago.—Cardwell friction draft-gear and Cardwell rocker side bearings.

Carey, Philip, Mfg. Co., Lockland, Cincinnati, Ohio.—Plastic freight car roofing; building roofing, locomotive boiler lagging; train pipe covering, and magnesia and asbestos goods of all kinds.

Chicago Car Heating Co., Chicago.—Full-sized models of the vapor system of car heating, in operation; also steam specialties.

Chicago Pneumatic Tool Co., Chicago.—Boyer pneumatic hammers; Keller pneumatic drills and other pneumatic tools for railroad use; Duntly air-cooled electric drills; electric grinders; also a duplex steam two-stage air compressor fitted with mechanically-operated inlet valves. The compresses supply air for operating a number of the compressed appliances on the Steel Pier.

Chicago Railway Equipment Co., Chicago.—The "Monitor" car bolster; National Hallow, Creco, Diamond and Kewanee brake beams; Creco roller-side bearings, and the "Creco" journal box and lid.

Cleveland Pneumatic Tool Co., Cleveland, Ohio.—Reversible and non-reversible air drills; wood boring machines; electric drills; pneumatic shipping, calking, beading and riveting hammers; pneumatic drift-bolt drivers; Bowes hose-coupling and plain and armored air hose.

Coe Brass Mfg. Co., Ansonia, Conn.—Patent Extruded Brass in step nosings, step treads and platform bindings; car door, window and eave moldings; architectural and automobile moldings; special shaped bars and rods and extruded metal in various forms to supersede castings.

Columbus Pneumatic Tool Co., Columbus, Ohio.—The U. & W. piston air drills; Dunlop piston air drills, and the Ulrich "Perfect" flue roller.

Commercial Acetylene Co., New York.—Acetylene gas lighting fixtures and apparatus for the storage of acetylene gas in cylinders filled with porous substance and acetone. This system is shown in operation on a New York, New Haven & Hartford passenger car on track; also acetylene locomotive headlight; locomotive marks; yacht searchlight and portable table lamps.

Consolidated Car Heating Co., Albany, N. Y.—Steam car heating apparatus; automatic steam couplers; automatic traps; heavy valves and fittings; electric heaters; regulating switches, and the McElroy automatic axle lighting system shown in operation.

Consolidated Railway Electric Lighting & Equipment Co., New York.—"Axle Light" system for electric car lighting, showing new type "D" dynamo running at all speeds without variation in current output or voltage, the current and voltage being controlled by the new "Kennedy" regulator.

Crandall Packing Co., Palmyra, N. Y.—Crandall packing for air pumps, throttle valves, etc.

Crescent Machine Co., Leetonia, Ohio.—Band saws; saw tables; joiners and other woodworking machinery.

Crosby Steam Gage & Valve Mfg. Co., Boston, Mass.—Recording gages, steam and hydraulic gages, safety valves, locomotive chime whistles, globe and angle valves and Johnstone blow-off cocks.

Curtain Supply Co., Chicago.—Car curtains fitted with Forsyth No. 86; Forsyth "Ring"; Keeler eccentric and Burrowes roller-tip fixtures; also Acme and Climax cable fixtures, as well as a full line of curtain materials.

Davis, John, Co., Chicago.—Steam specialties; air hose couplings; flexible steam joints; reducing valves; back pressure valves and swing joints.

Davis Pressed Steel Co., Wilmington, Del.—Davis solid-truss brake-beams for 100,000-lb. capacity freight cars; also high-speed beams for passenger car service. A special brake-beam testing machine of 150,000 lbs. capacity in operation.

Dearborn Drug & Chemical Works, Chicago.—Boiler compounds; anti-foaming compounds for locomotives, and samples of scale.

Detroit Seamless Steel Tube Co., Detroit, Mich.—Seamless steel locomotive flues; also samples of material showing the process of manufacture from the billet to the finished tube.

Dickinson, Paul, Chicago.—Engine-house smokejacks, including "Vitribestos" jacks, cast-iron movable engine-house jacks; also cast-iron ventilators and chimneys.

Dill, T. C., Machine Co., Philadelphia, Pa.—16-in. traveling head Dill slotting machine.

Dixon Crucible Co., Joseph, Jersey City, N. J.—Dixon silicate graphite paint and Dixon's graphite lubricants; Dixon's American graphite pencils; graphite greases and plumbago crucibles.

Dossert & Co., New York.—Solderless connections and terminals for electrical wires and cables; one sample connection for a 2,000,000 c.m. hard-drawn copper cable for the N. Y. C. & H. R. R. R. having a tensile strength of 30,000 lbs.

Dressel Railway Lamp Works, New York.—Headlights; switch and signal lamps; semaphore lamps with long-burning founts; interchangeable classification lamps, and steam and water gage lamps; also post and caboose lamps.

Duner Co., Chicago, Ill.—Water closets for railroad cars.

Edwards Company, The O. M., Syracuse, N. Y.—An entire new exhibit of window fixtures; vestibule trap doors, and tin barrel spring rollers for curtains.

Electric Storage Battery Co., Philadelphia, Pa.—Latest types of "Chloride Accumulator" for car lighting, signal service, etc.

Falls Hollow Staybolt Co., Cuyahoga Falls, Ohio.—Hollow staybolt bars of various diameters in 10-ft. lengths; also samples of raw materials from which the bars are rolled.

Flannery Bolt Co., Pittsburg, Pa.—The Tate flexible staybolt and special tools for applying the same; also illustrations of various installations.

Foster, The Walter H., Company, New York.—Two Lassiter staybolt threading and reducing machines and samples of work; also one model tool grinder.

Fox Machine Co., Grand Rapids, Mich.—Fox universal wood trimmers;

adjustable saw dodo or gaining heads, mitre machines, heavy tube or flue cutting machines, and the Fox high-speed single and multiple spindle drills and light milling machines.

Franklin Railway Supply Co., Franklin, Pa.—McLaughlin lock nuts, McLaughlin metal flexible conduit, Franklin driving-box lubricator; Franklin pneumatic fire-door openers; Franklin Piston Head and Cross-Head Attachment and Holland Metal Flexible Joint.

Frost Railway Supply Co., Detroit, Mich.—The Harvey friction draft spring shown as applied to the Butler, Farlow, Adjustable and Monarch draft gears.

General Electric Co., Schenectady, N. Y.—Track exhibit of electric locomotive No. 3404 for the New York Central lines.

General Storage Battery Co., New York.—Bijur "High-Duty" type standard car lighting cells, in double compartment tanks, as provided for the Pennsylvania Railroad; two types of charging boosters, for charging Bijur "High-Duty" storage batteries, consisting of a constant speed motor driving a separately excited generator; several sizes of one and two-cell types of Bijur storage batteries; standard battery case for railroad signals, and a switchboard demonstrating on a miniature scale the operation of fluctuating loads such as met with on electric elevators, electric hoists and electric cars and trains.

Gold Car Heating & Lighting Co., New York.—Electric, hot water, steam and storage car heating apparatus.

Gould Coupler Co., New York.—Gould Z-beam steel platform for passenger cars; friction buffer draft gear; freight car couplers; journal boxes; car bolsters and draft arms and friction draft gear; tandem draft gear, for wood and steel sills; spring buffers and tender couplers and brake-beam clamps.

Gould Storage Battery Co., New York.—The Gould electric car lighting system; also storage battery cells for signal use, and portable and stationary type batteries.

Green, Tweed & Co., New York.—Palmetto packing and the Favorite reversible wrench and the "Exacto" packing cutter.

Grip Nut Co., Chicago.—Grip nuts from ⅜-in. to 1¾-in.

Hale & Kilburn Manufacturing Co., The, Philadelphia, Pa.—Full line of car seats for all service, including both single and double reclining chairs.

Edwin Harrington Son & Co., Inc., Philadelphia, Pa.—Differential, screw and spur-geared chair hoists.

Heath & Milligan Mfg. Co., Chicago.—Steel panels showing "Ferrigo" joint; also crystals showing coach and car colors.

Heywood Bros. & Wakefield Co., Wakefield, Mass.—Seats for street and railroad cars; also brass model showing mechanism of the Wheeler seat.

Home Rubber Co., Trenton, N. J.—Samples of N. B. O. sheet packing and sectional tubular gaskets; also air brake and steam hose, throttle packing and inlaid rubber matting, as well as a full line of mechanical rubber goods.

Hunt-Spiller Mfg. Corporation, Boston, Mass.—Hunt-Spiller gun-iron castings for locomotives, such as eccentrics, eccentric-straps, cylinder bushings, cylinder packings, piston valve packing, piston-valve cages, driving boxes, driving-box shoes and wedges, cross-head shoes and gibbs, superheater headers, gears, etc.

Homestead Valve Mfg. Co., Pittsburg, Pa.—Homestead valves, including straight-way, three-way, four-way, locking cock and locomotive blow-off valves.

Independent Pneumatic Tool Co., Chicago.—Pneumatic tools and appliances, including "Thor" pneumatic drills, hammers, air turbines, flue rollers, air operated cold saws, etc.

Ingersoll-Rand Co., New York.—Pneumatic tools, including drills and hammers; also motor hoists, forges, etc.; also a Class H. C. compound air compressor. This compressor is in operation and furnishes air for operating pneumatic tools on the Steel Pier. An Imperial Class X air compressor is also on exhibit.

H. W. Johns-Manville Company, New York.—"Transits," asbestos smoke jack and fireproof lumber; Portland sectional conduit; asbestos textile materials, fibres and cements; Keystone hair insulator, roll fire felt, asbestos mill board, pipe coverings, cement felting; Kearsarge flange joint packings and gaskets; Standard piston-rod packing, Canada asbestos wick packing; asbestos roofings; Keystone combination pump packing, Vulcabeston pump packing, union washers and throttle-rod packing and, 85 per cent. magnesia and fire felt and sectional boiler lagging.

Johnson & Johnson, New Brunswick, N. J.—Equipments for first aid to the injured; specially designed for railroad use. The booth is made up exclusively of the products of the company.

Philip S. Justice Co., Philadelphia, Pa.—Reliance hydraulic jacks and Justice spring power hammers.

Kennicott Water Softener Co., Chicago.—Photographs of water softener installations; also map showing location of the company's apparatus on the various railroads of this country.

Kent Co., Edward R., Chicago.—Allen's high-speed tool steel and carbon steel high-speed twist drills; also samples of the ingredients used in making this steel.

Landis Machine Co., Waynesboro, Pa.—Bolt threading and nut-tapping machines; also samples of work.

Landis Tool Co., Waynesboro, Pa.—No. 3, plain grinding machine and a No. 16 gap railroad grinder; also samples of work.

Latrobe Steel & Coupler Co., Chicago.—Chicago, Melrose, Latrobe, Lewis-Seely pilot and tender couplers; Goodman wrecking hook; repair knucklers and pivot pins.

Locomotive Stoker Co., The, Chicago.—The W. H. Strouse automatic locomotive stoker in operation.

Lupton's Sons Co., David, Philadelphia, Pa.—Automatic sheet metal window frames and sashes, glazed with wire glass; ornamental copper panels; skylights, etc.

Macleod & Co., Walter, Cincinnati and New York.—Oil rivet forge; "Buckeye" light; whitewash sprayer; tire expander; sand blast and Buckeye heaters; compound air type, and independent type; also an acetylene torch-light.

McConway & Torley Co., Pittsburg, Pa.—Janney freight couplers; Kelso freight couplers; Pitt freight couplers; Kelso tender couplers; Kelso pilot couplers; Janney passenger car couplers, and Buhoup 3-stem coupler; the Buhoup 3-stem coupler applied to standard steel platform.

McCord & Co., Chicago.—Gibraltar bumping posts; McCord journal boxes; draft gear; spring dampeners; McCanna force-feed lubricators for both car and locomotive use in operation; McKim gaskets, an an hydraulic testing machine for showing the capacity of draft gear.

Manning, Maxwell & Moore, New York.—Grindley automatic machine tool and a Moore twist drill grinder; also The Hancock Inspirator Co.'s inspirators and ejectors; steam and check valves and whistles; The Hayden & Derby Mfg. Co.'s metropolitan injectors and ejectors; The Consolidated Safety Valve Co.'s safety valves; The Ashcroft Mfg. Co.'s steam gages; air gages; hydraulic gages; vacuum gages, and the Edson recording steam gages and indicators and planimeters.

Mason Regulator Co., Boston, Mass.—Full size models of the Mason locomotive reducing valve and Mason regulator.

Michigan Lubricator Co., Detroit, Mich.—New type of double, triple and quadruple sight-feed lubricators, with the sight-feed glasses around the oil reservoir as well as on top; also an automatic drain stem which drains the water from the lubricator and closes automatically, thus avoiding the loss of oil.

Modoc Soap Co., Philadelphia, Pa.—A demonstration of the "Perfect" car cleaner on a car at the Pennsylvania station.

Moran Flexible Joint Co., Louisville, Ky.—Metallic flexible joints and steam couplers.

Morse Twist Drill & Machine Co., New Bedford, Mass.—Morse drills, reamers, cutters, taps, dies, chucks, etc.

Moss, Albert Augustus, Allegheny, Pa.—The Moss "Excelsior" car coupler for freight cars, passenger cars and locomotives.

Nathan Mfg. Co., New York.—Monitor and Simplex injectors, both lifting and non-lifting; Buckeye lubricators, 2, 3 and 6 feeds; "Phillips" double-safety boiler check; "Freedman's" force-feed lubricating pumps; fire extinguishers; boiler washers and testers; oil cups of various designs; and the Coale safety pop-valve, etc.

National Car Coupler Co., Chicago.—Working models showing National passenger platforms and platform buffers; National centering yoke and the improved National passenger coupler No. 6; also Hinson emergency knuckle and Hinson draft riggings.

National Lock Washer Co., Newark, N. J.—Nut locks; curtain fixtures; car curtains; sash locks and sash balances.

National Malleable Castings Co., Cleveland, Ohio.—Tower and Climax couplers.

New Castle Forge & Bolt Co., New Castle, Pa.—Bolts, forgings and chains.

New York Air Brake Co., New York.—Forsythe automatic air and steam couplings in operation.

Niles-Bement-Pond Co., New York.—Niles 90-in. driving-wheel chucking lathe in operation; located in a special booth near the Pennsylvania R. R. station; also an office on Steel Pier.

Norton Emory Wheel Co., Worcester, Mass.—The main feature of the exhibit is a column, 15-ft. high, composed of 18-in. "Alumdum" wheels, surmounted by a large ball and an American eagle all made of "Alumdum." Various forms of wheels and oil stoves are also shown.

Norton Grinding Machine Co., Worcester, Mass.—Samples of work, such as piston rods, crank pins, valve stems, etc., done on a grinding machine especially designed for railroad work.

Norton, A. O., Boston, Mass.—Norton ball-bearing lifting jacks and "Sure Drop" track jacks.

Page Car Company, Boston, Mass.—Track exhibit of the Page flat bottom dump car.

Pennsylvania Rubber Co., Jeanette, Pa.—Pennsylvania interlocking rubber tiling; pebbled and corrugated rubber matting; "Century" white sheet packing; "Century" tubular gaskets; red sheet packings and tubular gaskets; red, white and black garden hose; suction hose and corrugated tender hose.

Phillips, F. R., & Sons Co., Philadelphia, Pa.—Laffitte welding plates and "Velos" high speed twist drills.

Pittsburg Steel Co., Pittsburg, Pa.—"Pittsburg Perfect" electrically welded fence. Fence making machine in operation, making about 7 miles of railroad right of way fence per day.

Ralston Steel Car Co., Columbus, Ohio.—Track exhibit of the Ralston flush floor drop bottom steel car.

Rich, Geo. R., Mfg. Co., Buchanan, Mich.—Improved high-speed flat drills and chucks; expanding mandrels; boring bars; arch-bar drill presses and other improved machine shop appliances.

Rubberset Brush Co., Newark, N. J.—"Rubberset" paint brushes for railroad use.

Jos. T. Ryerson & Son, Chicago.—Lenox beveling shear, Ferguson flue-welder; Simplex track and car jacks; Ryerson's key-seating machine; model of Ryerson's flue-cleaning machine; Ryerson's oil furnace for flue welding, and a number of small tools such as flue cutters, etc.

Safety Car Heating & Lighting Co., New York.—"Standard" system of steam heating. Models showing the system as applied to passenger cars; also various parts of the apparatus cut out to show construction. Safety steam coupling.

Schoen Steel Wheel Co., Pittsburg, Pa.—Pressed and rolled steel wheels, showing the various stages of manufacture.

Seamless Tube Co., of America, Pittsburg, Pa.—Seamless wrought steel locomotive boiler flues; seamless forged steel locomotive safe ends and seamless forged steel locomotive arch or Superheater tubes.

Shelby Steel Tube Co., Pittsburg, Pa.—Seamless steel tubing for locomotive flues; link bushings, and seamless steel locomotive bells.

F. F. Slocomb & Co., Wilmington, Del.—Two portable pneumatic punches; one pneumatic riveter and one Slocomb hot-air engine.

Sprague Electric Co., New York.—Sprague electric trolley hoist; also steel armor hose for compressed air or steam.

Standard Paint Co., New York.—Model of the Pennsylvania R. R. roundhouse, covered with Ruberoid roofing. Ruberoid roofing for railroad cars and locomotive cabs; Giant insulating papers; P. & B. and S. P. C. insulation, and Ruberoid permanent colored roofing; flexible metal preservative paints and P. & B. new insulating varnishes baking and air-drying. The exhibition pavilion is covered with Ruberoid colored roofing.

Standard Steel Works, Philadelphia, Pa.—Solid rolled steel wheels; steel-tired wheels; steel tires and springs.

Starrett, L. S., & Co., Athol, Mass.—Full line of mechanical instruments; also hack saws and leveling instruments, steel tapes, etc.

Stoever Foundry & Mfg. Co., Meyerstown, Pa.—Pipe threading and cutting-off machines.

Symington, The T. H., Co., Baltimore, Md.—Journal boxes; ball-bearing center plates and side bearings for railroad cars; also a demonstration showing method of grinding side bearing race plates for ball-bearing side bearings.

Underwood Co., H. B., Philadelphia, Pa.—Portable cylinder boring bar; portable 2-cylinder air motor for driving tools, dome facers, portable valve facing machine; Mongs boring table for lathes and a portable crank-pin turning machine.

U. S. Metal & Mfg. Co., New York.—The Columbia nut lock; Victor cast-steel car replacers; "Perfect" cast-steel car replacers; Gilbert automatic hose reel; the West malleable iron brake jaw; "Almetl" lumber stake; "Ideal" draw-bar centering device and the Feusable drop brake staff; also a track exhibit of a car equipped with the various specialties made by the company.

Wagenhorst Co., J. H., Youngstown, Ohio.—Electric blue printing apparatus in operation.

Wells Light Mfg. Co., New York.—Lights of one, three and five burners for contractors and general outside use; tire-heating device and a tripod stand for use in foundries.

Westmoreland Coal Co., Philadelphia, Pa.—Full-size wooden model of standard locomotive tender loaded with Westmoreland screened coal.

Westinghouse Air Brake Co., The, Pittsburg, Pa.—Two 75-car racks of 10-in. freight equipment, combined type, for the purpose of comparing present standard and improved freight equipment; also a comparison of old engine and new "ET" equipments; new 8½-in. cross-compound steam-driven air pump; Westinghouse friction draft gear; Westinghouse type "K-1" and "K-2" triple valves shown in section; also No. 5 distributing valve used in connection with new "ET" equipment; American Brake Co.'s automatic slack adjuster for passenger equipment; model of engine truck fitted with equalized brake and slack adjuster; also model of locomotive driver fitted equalized brake gear; Westinghouse Automatic Air & Steam Coupler Co.'s automatic air and steam couplers applied to freight and passenger equipment (shown in model cars); Westinghouse Electric & Mfg. Co.'s enclosed type multiple d. c. arc lamps and the Cooper-Hewitt mercury vapor lamps; also various types of a. c. and d. c. fan motors and different types and sizes of a. c. and d. c. motors, ranging in size from 1¼ h. p. to 15 h. p. The power for operating the various equipments mentioned is furnished by four D-4-E-G and one C-4-A-G motor-driven air compressors, which are governed by five "J-13" electric pump governors, all built by the Westinghouse Traction Brake Co.

West Disinfecting Co., New York.—Disinfectants for all purposes and apparatus for applying the same.

Western Railway Equipment Co., St. Louis, Mo.—Western drill and carline pockets; Western brake jaws; Hoerr tandem draft gear; Acme pipe clamps; Linstrom syphon pipes; Linstrom eccentrics; Missouri Hoerr Western flush, St. Louis flush, and Interchangeable car doors; Western truck end castings; Economy track adjusters; Western bell ringer; car door fastenings; Fish-hook tie plate and brake pins.

Wheel-Truing Brake Shoe Co., Detroit, Mich.—A brake shoe fitted with an abrasive for truing and dressing flat and worn wheels.

Whitney Mfg. Co., Hartford, Conn.—Photographs of hand-feed milling machines; 20-in. water tool grinder; "Presto" chuck and colletts; Woodruff system of keying; roller and block chains for automobiles, and the Hartford printer for hotel menu cards.

Yale & Towne Mfg. Co., New York.—Three types of chain blocks, including triplex, duplex and differential hoists. Also electric hoists and overhead trolleys. A large assortment of locks, including Yale locks, cabinet locks and padlocks. A full line of builders' and car hardware and Blount door checks.

## Recent Development of American Passenger Locomotives.

BY GEORGE L. FOWLER,
Associate Editor of the *Railroad Gazette*.

In the latter part of the seventies it was thought by a goodly number of American railroad men that the locomotive had reached the upper limit of its power. The standard stroke of practically all road engines in the country was 24 in., and 16 in. was the diameter of the cylinders, with a few scattering ones of 17 in. and 18 in. for particularly heavy work. The boilers were carrying an average pressure of 125 lbs., with 140 lbs. in exceptional instances, and contained a total heating surface of about 1,200 square feet. In a discussion before the Master Mechanics' Association it had been the consensus of opinion that 12,000 lbs. was the limit of weight that could be safely placed upon a single wheel. Under these limiting conditions we find that the passenger locomotive was what was long known as the American or eight-wheeled type, having two pairs of driving wheels and a four-wheeled truck in front, and weighed complete in working order about 80,000 lbs., of which 58,000 lbs. was upon the drivers.

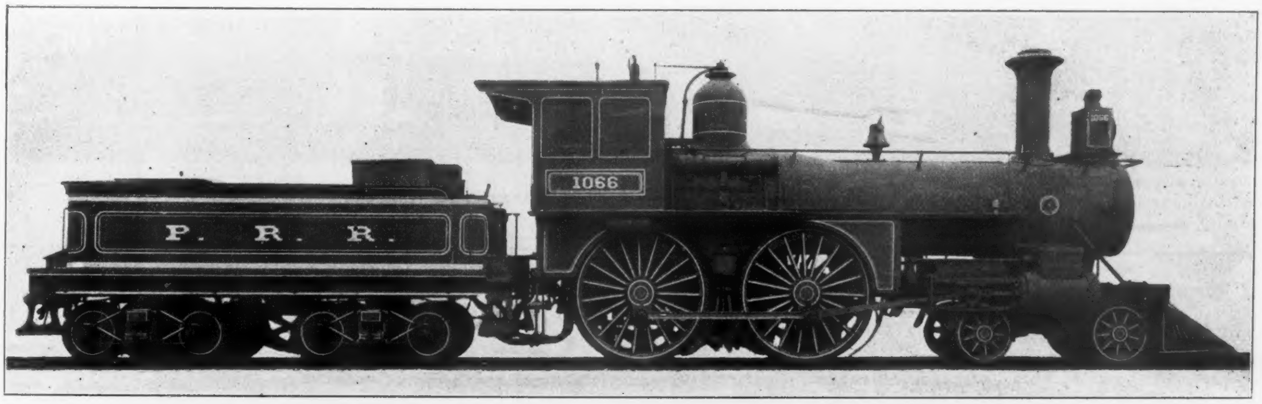
The boiler was of ⅜ in. steel and was carried with the center of its shell about 6 ft. 6 in. above the rails. The firebox was narrow and dropped down between the bar frames, the upper member of which was usually 4 in. square. The length was also limited by the distance between the driving axle, and this was, in turn, restricted by the length that it was considered safe to run the side rods. Under these conditions the grate surface of the best engines was about 36 in. wide and rarely more than 6 ft. 6 in. long.

At the same time the weights of the sleeping car equipment had increased so that forty or more tons per car was a common figure, and the operating departments of all of the trunk lines were calling for engines to haul heavier trains on a faster schedule. in constantly increasing numbers. The stability being established, the boiler was raised and increased in diameter until by 1892 we find engines of the eight-wheeled type in service weighing 123,000 lbs., of which 82,000 lbs. were upon the driving wheels. Such engines had cylinders 19 in. in diameter, with a piston stroke of 24 in. The boiler had a shell of 58 in. in diameter, the center of which was 9 ft. above the rails, and contained 1,800 sq. ft. of heating surface, with a grate 8 ft. long and 41 in. wide, while the steam pressure had risen to the unprecedented height of 180 lbs. per sq. in.

It will be at once apparent what a tremendous advance such an engine exhibited in comparison with the light machines of a decade before. The tractive weight, the heating surface and the steam pressures had all been increased by 50 per cent., resulting in a much greater ratio of increase of power for the engine as a whole.

Of course this weight of more than 20,000 lbs. upon the driving wheels could only be used on roads where the rail was heavy and the whole construction of the roadway of the most substantial character. Where light rails were still in service and it was desired to obtain the full benefits of the large boiler and the great total weight on drivers, the ten-wheeled locomotive was used. This had the same four-wheeled truck at the front, but was fitted with three pairs of driving wheels instead of two. Such engines frequently had cylinders 20 in. in diameter, and with the 1,800 sq. ft. of heating surface available, had a weight of about 100,000 lbs. on the driving wheels. This gave a somewhat greater tractive power than the lighter engine of the eight-wheeled type, but had the disadvantage of the extra side rod. So, while such engines did good service, they were not regarded with great favor by the officers of the motive power department, though many of them were built.

Up to this date the increase of heating surface had been obtained by an increase in the diameter of the shell and in the number of tubes placed therein, no change having been made in the diameter of the latter and but little in their length. Two inches had been the standard diameter of tubes in all American engines for many years, and their length had been about 12 ft., with an occasional spurt of 13 ft.




**Standard Eight Wheel Passenger Locomotive of the Pennsylvania Railroad, 1875.**

I remember being present at a conference in the office of a superintendent of motive power at the time, when a great variety of propositions were made with the end in view of securing a speed of sixty miles an hour with a heavy train. At the close the statement was made that it was a very simple thing to build a locomotive that would run at a speed of sixty miles an hour. But to build one that would attain and maintain that speed with a train of a dozen cars was an entirely different proposition.

The question then, as now, was a matter of steam, and most of the attempts at improvement were made along the lines of increasing the efficiency of the current type of boiler. Firebrick arches were introduced to a small extent, and the extended front fad, that made the locomotive look like a pouter pigeon, swept the country.

When designs had apparently reached their limits, a revolution was created by the introduction of the class K locomotive upon the Pennsylvania Railroad by Mr. Theodore N. Ely, who was at that time superintendent of motive power. He simply raised the boiler and placed the mud ring on top of the frames, above the driving axles, by which he was enabled to add about 7 in. to the width of the grates, while the length was limited only by the ability of the fireman to properly distribute the coal.

This move, on the first engine so built, increased the grate area from about 18 sq. ft. to 35 sq. ft. and the heating surface from 1,150 sq. ft. to 1,240 sq. ft. The steam pressure was held at 140 lbs. per sq. in. The weight in working order was 96,700 lbs., of which 70,600 lbs. were upon the driving wheels.

Many and dire were the predictions as to the instability of the new design, because of the unprecedented height of 7 ft. 5¼ in. at which the center of the shell was placed above the rails. But the machine not only did not upset, but ran with remarkable steadiness, and demonstrated from the outset the safety of the arrangement.

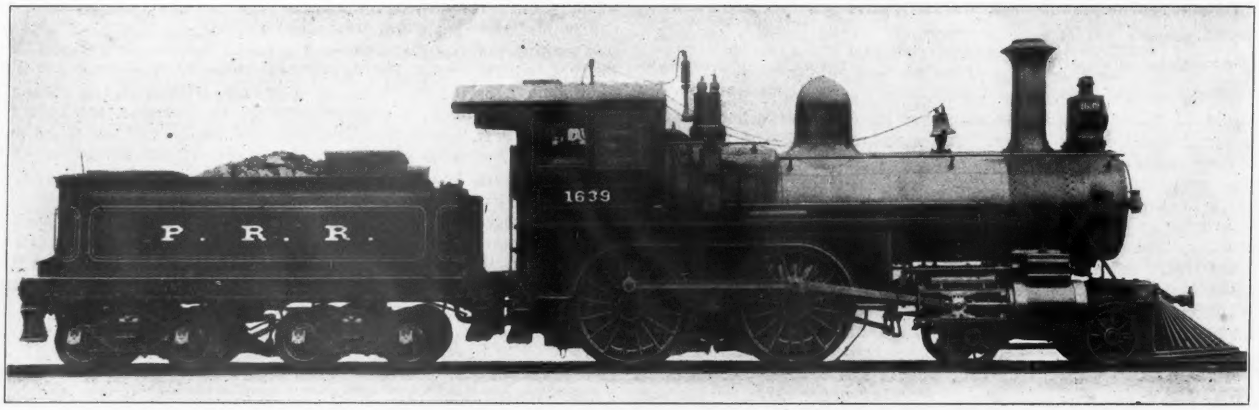
The advantages were so apparent that the wide firebox boiler at once became the vogue, and it was ordered upon new locomotives

Once again the railroads were confronted with the same problems that they had faced a dozen years before. The limits of locomotive growth seemed to have been reached. The only apparent solution was to increase the length of the tubes. This was cautiously undertaken. There was the fear that the vibration of longer ones would cause undue leakage at the firebox, while the looked-for gain in efficiency was but slight because of the rapidly decreasing evaporative power at the front end.

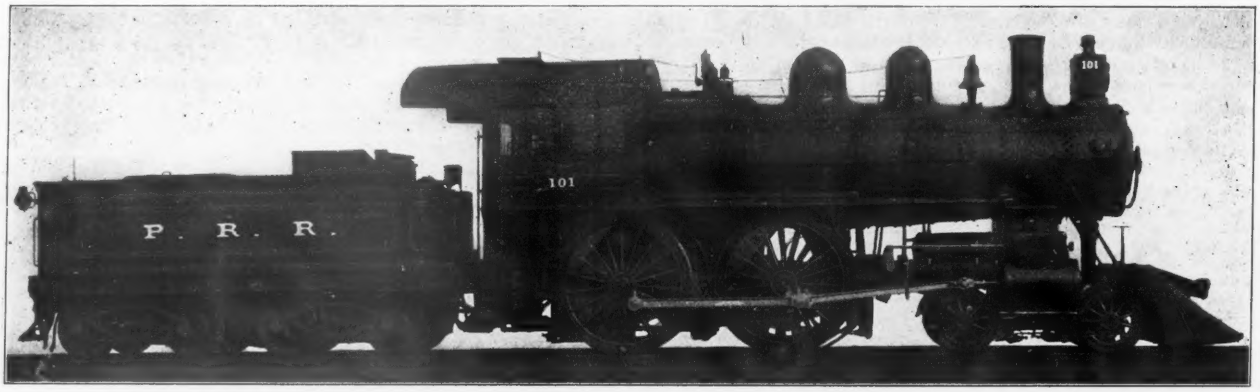
As in 1881, Mr. Ely solved the problem of the narrow firebox by putting a wide one on top of the frames, so in 1893 the Baldwin Locomotive Works solved the problem of the so-called wide firebox by the introduction of a still wider one, in the engine Columbia, which was exhibited at the Chicago Exposition. As this engine had a two-wheeled truck in front, and as the American railroad man is prejudiced against this arrangement for high-speed work, only this one exhibition engine was built, and the type was at once modified into what is now known as the "Atlantic." This engine has a four-wheeled truck at the front, followed by two pairs of driving wheels, both of which are in front of the firebox, the rear pair being the main drivers. The firebox is carried by a single pair of trailing wheels of a somewhat larger diameter than the forward truck wheels, but still small enough to permit the bottom of the firebox to extend out over them.

With this arrangement the width of the firebox was limited only by the clearances of the permanent way, and the length was left unrestricted as heretofore; an increase merely involving an increase of engine length.

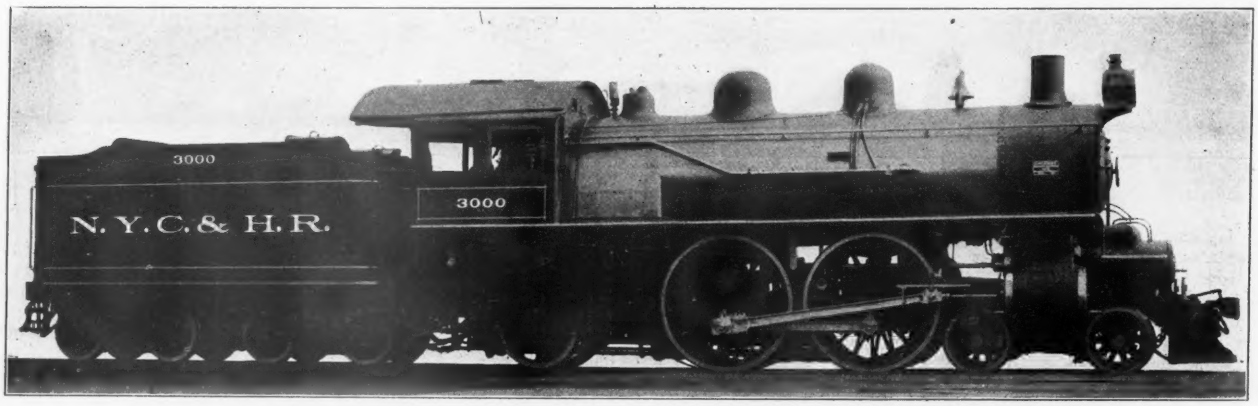
Naturally the first engines built on these lines were not very



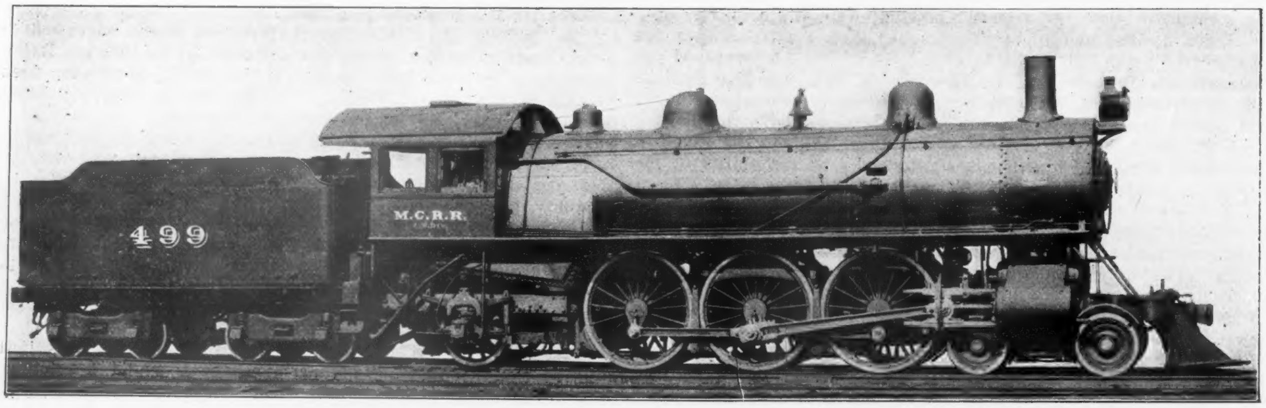

Class K Locomotive, Pennsylvania Railroad, 1882, for Passenger Service.




Eight Wheel Passenger Locomotive for Pennsylvania Railroad.




Atlantic Type Passenger Locomotive for New York Central & Hudson River.



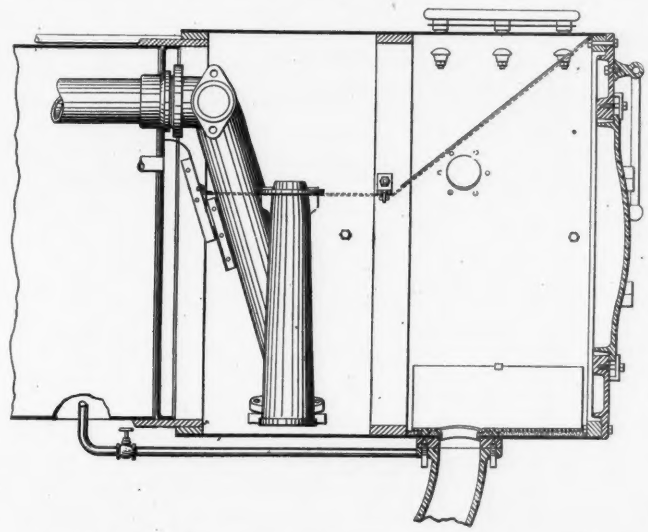

Pacific Type Passenger Locomotive for the Michigan Central.

much larger than those they were to supersede. We find in the Columbia, for example, that there was 83,140 lbs. upon the driving wheels, while the heating surface was but 1,478 sq. ft. Such conditions, however, with such opportunities, could not be expected to stand; though at a date of more than a year after the close of the World's Fair we find engines of the Atlantic type sent out with 86,000 lbs. upon the driving wheels and a heating surface of less than 1,600 square ft. The advantage gained by the new construction lay solely in the decreased rate of combustion upon the grates.

Soon the demands for higher sustained speed for heavy trains began to make itself felt, and the boiler of the Atlantic type of engine began to grow. We find a lengthening of the tubes, an increase in the diameter of the shell and the number of the tubes, until at the opening of the new century, the Pennsylvania Railroad presents, as its latest development, an engine of this class having a firebox 8 ft. wide and 8 ft. 6 in. long; a total heating surface of 2,320 sq. ft. and a weight on the four driving wheels of 101,500 lbs., or more than twice as much per wheel as was considered proper practice 20 years before. Still, even in this engine the tubes had not grown very much, as they are still but 13 ft. long between the sheets. The cylinders were 20½ in. in diameter, with a piston stroke of 26 in.

Since then these dimensions of cylinders have not been greatly exceeded, 21 in. in diameter being about the upper limit for passenger service, but the tubes have been lengthened to 16 ft. 6 in. for common practice and even to 20 ft. on occasions, and a heating surface of more than 3,100 sq. ft. obtained. The diameter of the boiler has risen to 72 in., in which more than 300 tubes are placed, while the steam pressure carried stands at 200 lbs. or more per square inch.

The Atlantic type of engine shows the lines along which the



General Smokebox Arrangement on American Locomotives.

passenger engine has been developed, and with it we find modifications of the ten-wheel or 4-6-0 type.

A recent example of this modification is to be found in the Pacific, or 4-6-2 type, in which the trailing truck of the Atlantic is added to the ten-wheeler.

Such an engine of modern dimensions would weigh about 230,000 lbs., of which 150,000 lbs. would be on the driving wheels. It would have a cylinder diameter of 22 in., with a piston stroke of 28 in. The boiler would carry a steam pressure of 200 lbs. per sq. in. and have a firebox measuring 9 ft. by 6 ft. 3 in., and a shell 6 ft. in diameter, containing 354 tubes 20 ft. long, with a total heating surface of 3,894 sq. ft. This may be regarded as the latest development in the increase of power of the passenger engine.

Let us now glance back and see what this growth really means. In the seventies our large engines had cylinders 17 in. in diameter, with a stroke of 24 in., working with a steam pressure of 140 lbs. per sq. in. Now these dimensions are 21 in. and 26 in., respectively, and the boiler pressure 200 lbs., making an increase in tractive effort of a little more than 151 per cent., which corresponds almost exactly with the increase in heating surface from 1,200 to 3,100 sq. ft. In other words, the American passenger locomotive of to-day is capable of doing two and a half times as much work as its predecessor of twenty-five years ago, while if we base the estimate on the heavy Pacific instead of the Atlantic type, 20 per cent. must be added to that, and we have a machine capable of doing more than three times the amount of work that could be done by the heavy engines of the seventies.

It would be but a meager source of pride for the American engineer, if mere bigness was all that he had to show for the work of a quarter of a century. He has, however, far more than this to his credit. The locomotive has not only grown in size but in efficiency. While he has been adding to the dimensions he has been developing and perfecting every detail of the design. In the conventions and railroad clubs he has discussed the machine, item by item, from the nose of the pilot to the drawbar at the rear of the tender.

When Mr. Ely brought out his class K, the valves were so heavy and hard to move that a steam reversing gear was installed to do the work. Then came the balanced valve, and experiment upon experiment was tried until the valves of heavy engines with 20 in. cylinders could be moved more easily than the old ones with 16 in. diameter. This was followed by the introduction and development of the piston valve.

In the machinery of the engine of 1878 cast-iron entered very largely into all parts. Pistons, crossheads and driving boxes were all of this material. As the size of the engines increased, the weights of reciprocating parts tended to become so heavy as to threaten destruction to the machine and the track. Then steel castings were introduced and the weight saved here was put into the boiler to increase the steaming capacity.

In the boiler we find first the almost universal use of the crown-bar for staying. This has been supplanted by the radial stay, or by fireboxes of the Belpaire type. After the firebox was lengthened when placed upon the top of the frames, there came increased trouble with broken staybolts, due to the greater variation in the expansion between the inner and outer sheets. This led to trial upon trial of various forms and flexible stays, and of various classes of metals of which to make them.

The increased duty demanded of the engine called for an increase in coal consumption, and, at the same time the complaints of passengers on the score of smoke nuisance were loud and bitter. The combination of the two led to the work of developing the firebox and front end, with the result that a far better combustion than was dreamed possible in the early days is now attained, and that, too, with but comparatively little production of smoke. The three elements contributing to this are the brick arch in the firebox, the Master Mechanics front end, and the instruction of the engineers and firemen as to the proper methods of firing in order to obtain the desired results. Before the present form of what is known as the front end recommended by the Master Mechanics' Association was brought out, and subsequently modified, the American locomotive carried many and curious contrivances to prevent the production of smoke.

In addition to work on the locomotive proper there has been a great improvement in all the fittings. The air-brake has been a marvelous development, from the straight air of the early seventies to the automatic and thence to the quick action. The headlight, that characteristic feature of the American engine, has been brightened from the oil lamp that merely served to make the darkness visible to the man behind it, to the electric arc that really does illumine the track ahead.

Thus it would be possible to go on through all of the items of construction and find in each a subject worthy of a chapter, by the combination of which that whole has been accomplished which has already been set forth.

In what has been said regarding the development of the American passenger locomotive, attention has been confined strictly to the bituminous coal burning engine, as that really represents typical American practice. Other classes of engines are found in special localities, but their use is restricted. For example, we find, on the roads leading out of the Pennsylvania anthracite coal fields, that the wide firebox of the Wootten type placed above the driving wheels is in universal use, and that it has felt the influence of the growth of the bituminous coal burning engine and shows important modifications along the same lines.

In the extreme southwest the discovery of the oil fields of Texas and southern California placed a cheap fuel at the disposal of the railroads that was at once utilized, and oil-burning engines are extensively used in those regions. But they can never spread over the country as a whole, and the bituminous coal-burning engine will always remain the standard.

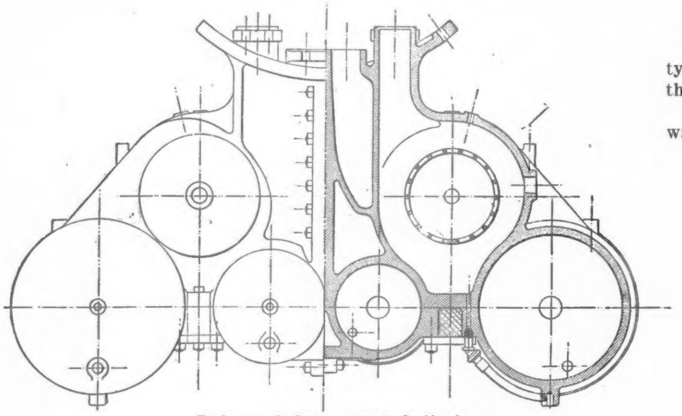
It must not be inferred that the Atlantic type of engine has entirely supplanted the eight-wheeled or the ten-wheeled for passenger service. Such is far from being the case, it merely represents an advanced type of development and should be considered as such. Very many of the older classes are being built every year and will probably continue to be for an indefinite period in the future.

Whether the development of that engine has reached or even approached its final form would be dangerous to say. Twice we have apparently been up to the stopping point, but a means was found to cross the barrier and the growth continued. The difference between those past conditions and the present is that then the engines were small and had room to grow, while now they are about out to the limits of the permanent way. Engines that measure 15 ft. from the rail to the top of the stack, that require a clear

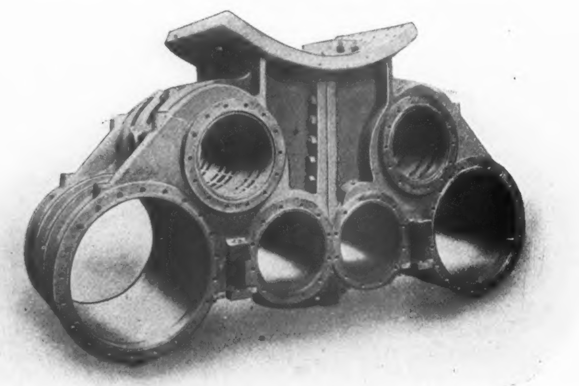
width of 9½ ft. to let them pass, and call for 75 ft. turntables to swing them, are no toys, and if they are made much larger they will call for an increase in permanent way clearances. Indeed, on some roads this is already being done. Finally, we are now facing the limits of elasticity in the materials of the rail and tire, and it remains to be seen as to how much farther the stresses on present material can be carried or a new material be brought out that will meet the increased demands that railroad managers stand ready to impose.

## Electrification of the Erie from Rochester to Mount Morris.

A length of 34 miles of the Rochester division of the Erie Railroad, Rochester to Mount Morris, is to be equipped for running cars by electric power, conveyed through an overhead trolley wire, and it is proposed to run trains of one car, or more if needed, each way every hour throughout the day. Electricity is to be bought from one of the companies which are preparing to transmit power from Niagara Falls, about 70 miles. On this long line the current will be transmitted at 60,000 volts. It will be delivered to the railroad through a transformer at Avon, 19 miles south of Rochester and 15 miles from Mount Morris, the transformer converting it to a pressure of 11,000 volts, which will be the pressure on the trolley wire. The design for the line shows wooden poles at one side of



Balanced Compound Cylinders.



Balanced Compound Cylinders.

the track, 120 ft. apart. The brackets will support over the center of the track a ⅜-in. galvanized steel "messenger" wire, and this in turn supports a $^4/_0$ copper wire, with six intermediate supports between each two brackets. The contact to convey the current to the car is not by a trolley wheel but by rubbing contact with a loop supporting a horizontal transverse wire or rod.

The company designs to use a passenger car weighing 35 tons, loaded, of which the body is estimated to weigh 11 tons. This will have two 100-h.p. a.c. motors, both on the same truck. The car will be 52 ft. long, over all. The passenger compartment will seat 44 passengers, while the baggage and smoking compartment, 8 ft. long, will have folding seats.

The motors are designed to propel the cars at an average speed of 22 miles an hour, including stops every mile, and the maximum speed on a level will be 40 miles an hour. In accelerating, a car will use 186 k.w. The motor truck will have 36-in. wheels and a wheel base of 6 ft. 8 in. The trailer truck will have a wheel base 14 in. shorter.

The transformer house at Avon will be 28 ft. x 40 ft. x 30 ft. high, and will have three 375 k.w. transformers.

The contract for the electrical work has been given to Westinghouse, Church, Kerr & Company, of New York City, and it is expected to have the work done within four months, or thereabouts.

## Balanced Compound Locomotives.

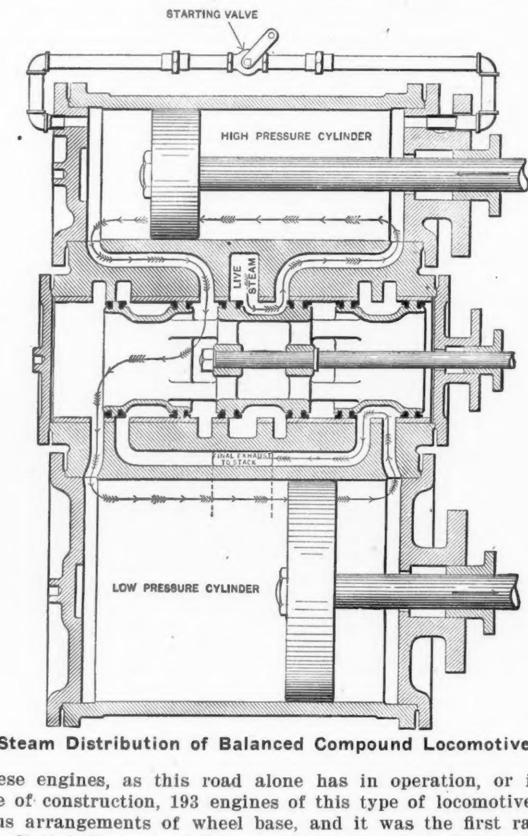
BY H. V. WILLE,
Assistant to the Superintendent of the Baldwin Locomotive Works.

The Baldwin Locomotive Works have built, or have under construction, 281 balanced compound locomotives distributed among a large number of railroads, as the following table will show:

| No. of engines. | Type. | Baldwin Loco. Works Class. | Name of road. |
|---|---|---|---|
| 41 | Pacific. | 12 28/50 ¼ D | Atchison, Topeka & Santa Fe. |
| 96 | Atlantic. | 10 24/44 ¼ C | Atchison, Topeka & Santa Fe. |
| 56 | Prairie. | 10 29/52 ¼ D | Atchison, Topeka & Santa Fe. |
| 20 | Atlantic. | 10 24/44 ¼ C | Chicago, Burlington & Quincy. |
| 4 | Pacific. | 12 28/50 ¼ D | Oregon River & Navigation Co. |
| 15 | Atlantic. | 10 26/48 ¼ C | Associated Lines. |
| 10 | Atlantic. | 10 24/44 ¼ C | Great Northern R. R. |
| 10 | Ten-wheel. | 10 25/44 D | Italian Government. |
| 8 | Atlantic. | 10 24/44 ¼ C | Chicago, Rock Island & Pacific. |
| 6 | Ten wheel. | 10 24/44 D | Seoul-Fusan R. R. |
| 3 | Ten-wheel. | 10 26/48 D | N. C. & St. Louis. |
| 2 | Ten-wheel. | 10 25/46 D | Chicago & Eastern Illinois. |
| 2 | Atlantic. | 10 26/48 ¼ C | Erie R. R. |
| 2 | Atlantic. | 10 26/48 ¼ C | Pennsylvania R. R. |
| 2 | Ten-wheel. | 10 24/44 D | New York, New Haven & Hartford. |
| 2 | Ten-wheel. | 10 24/44 D | Missouri, Kansas & Texas. |
| 1 | Atlantic. | 10 25/46 ¼ C | New York Central & Hudson River. |
| 1 | Ten-wheel. | 10 24/44 D | Chicago Short Line. |
| 281 | Total. | | |

It is apparent from the foregoing table that the merits of this type of engine are being determined by a court upon whose verdict the railroad world can place absolute reliance.

The progressiveness of the Atchison, Topeka & Santa Fe Railway, however, is largely responsible for the rapid growth in favor



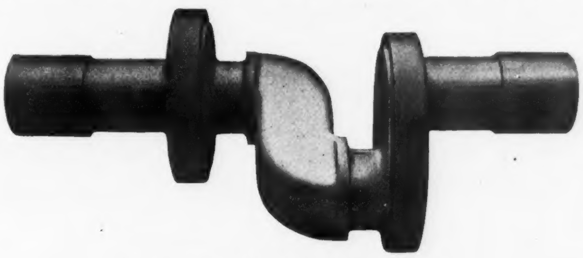

Steam Distribution of Balanced Compound Locomotive.

of these engines, as this road alone has in operation, or in the course of construction, 193 engines of this type of locomotive with various arrangements of wheel base, and it was the first railroad in the United States to fully appreciate the value of the balanced compound locomotive. They have divisions where balanced compound passenger engines are exclusively used, and the quiet assurance of their roundhouse men responsible for the maintenance of the engines is in strong contrast to the excitement usually prevalent when a new type of power is being used.

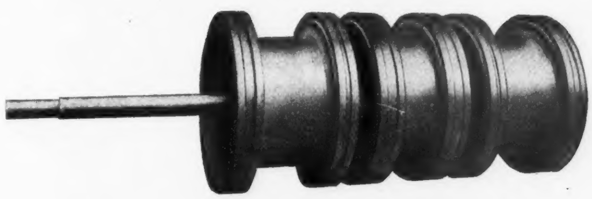
It has been but a step from the four-cylinder Vauclain compound locomotive, developed by the Baldwin Locomotive Works from 1890 to 1900, to the four-cylinder balanced compound of today. The earlier type of engine demonstrated that economy would result from compounding, and that such engines because of the wide port openings could maintain a higher speed than a single expansion engine. They also demonstrated that the use of four-cylinders was not objectionable because of high cost for maintenance or cylinder repairs. They were, however, more difficult to balance, and it was a natural step to accept the crank axle, which had always been looked upon by American engineers with prejudice

and misgivings. This fear, however, has been proven by the test of time to be groundless, as no trouble has been experienced with crank axles of American manufacture. In this American manufacturers have been more successful than their European brethren, because the Baldwin Locomotive Works was able to insist that crank axles should meet certain requirements before allowing them to be made.

The writer was sent abroad with instructions to negotiate for the purchase of 40 crank axles and to make a full report upon the



Built Up 2-Webbed Crank Axle.



Valve of Balanced Compound Locomotive.

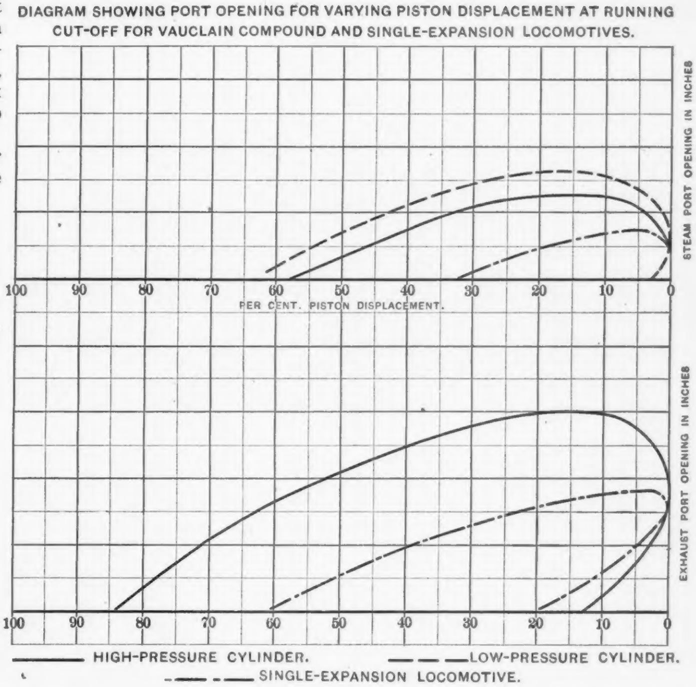



Diagram of Port Opening of Compound Engine and Single-Expansion Engine.

quality of material employed, the method of manufacture, the design and the cause of failure of crank axles in Europe, and the following facts developed from this investigation:

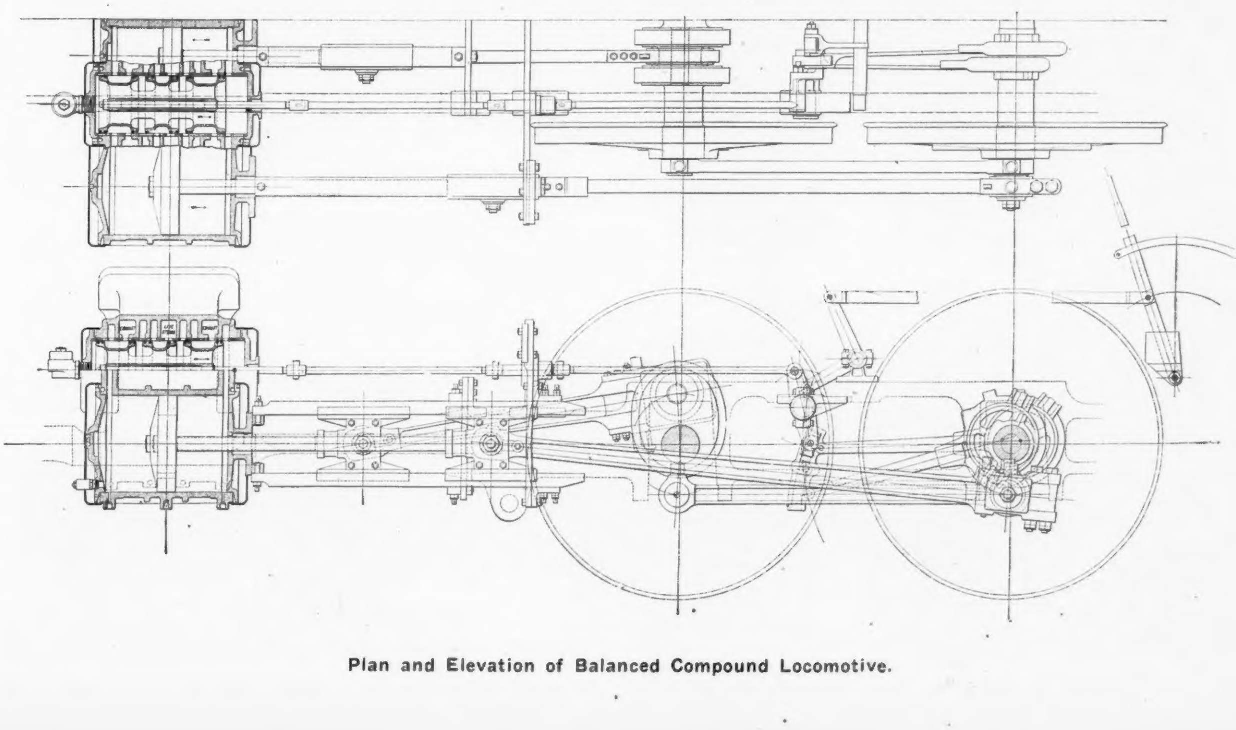
1. Axles are forged from small ingots and have insufficient work put upon them.
2. A great number of axles are made from soft steel.
3. Axles are generally designed by rule of thumb and in the light of previous experience rather than by calculation.

The webs are slotted out of the solid forged axle and the pins are composed of the central core of the ingot which may not only contain segregation and pipes, but which also derives but little beneficial effects of hammering or forging particularly when forged or pressed from a solid ingot. A solid axle of European make forged from a small ingot which was cut up for test amply confirmed this theory and showed the success of the American solid forged axle to be altogether due to the use of high carbon steel, large ingots, plenty of work and careful annealing.

The difficulty and the time required to make a proper crank axle forging led to the adoption of the built up axle. The component parts of this axle can be well worked and forged, and they are not liable to failure by fracture, and when the pins are worn below the limiting size it is easy to remove and replace them. This axle has met with a good deal of favor not only because of its low first cost and rapidity of manufacture, but also because of its low cost of maintenance.

The development of the compound locomotive was simultaneous with the introduction of heavy types of power now so prevalent, and many failures have been attributed to compounding features which were chargeable to rapid increase in the size of power. The stresses, however, in a balanced compound are much lower than those in a single expansion engine and seem to have provided a remedy for many of the most annoying and expensive engine failures. For example: There has been no frame or cylinder failure on any of this type of engine built by the Baldwin Locomotive Works, notwithstanding the fact that a single front frame rail has been employed upon the heaviest engines built.

In analyzing frame failures for a committee of the Master Mechanics' Association, the writer was impressed with the fact that

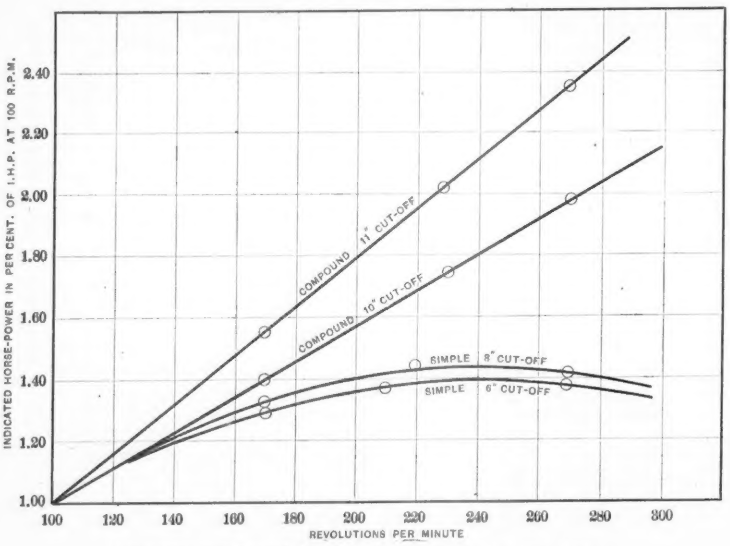


Plan and Elevation of Balanced Compound Locomotive.

90 per cent. of these failures ahead of the main drivers occur upon the side of the engine of the leading crank pin.

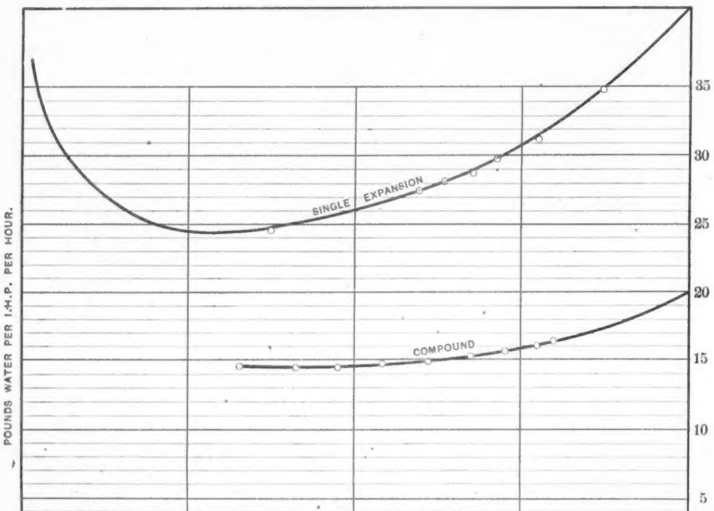
The majority of the stresses act equally on both frames, but the stresses set up by the pounding of the journal boxes between the pedestals when the cranks pass their dead points are not equally distributed. When the right-hand crank leads, the right-hand frame is stressed more severely than the left-hand, and when the left-hand crank leads the left-hand frame is more severely stressed. The diagram shows the forces which produce the pounding of the boxes at the four dead points. The elevation shows the crank pin positions and the direction of the forces transmitted from the cylinders through the rods. The full arrows represent the right crank and dotted arrows the left. In the plan view the arrows at the ends of the axle represent the forces coming from the rods, while the arrows inside and close to the frames represent the resulting stresses acting on the frames.

In Fig. No. 1 the right-hand crank is passing the forward dead point. The right-hand box is thrown backwards and the left-hand




**Horsepower Speed Curve of Compound Locomotive.**

WATER RATE CURVES OF
COMPOUND AND SINGLE EXPANSION LOCOMOTIVES.

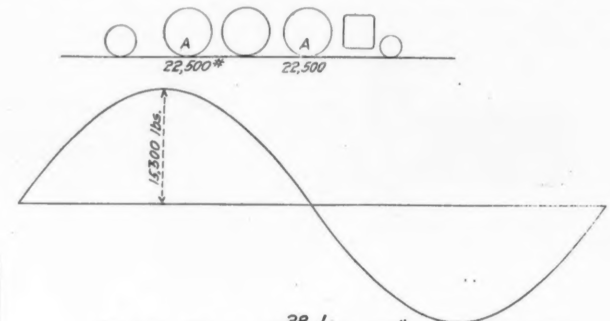



**Water Rate Diagram.**

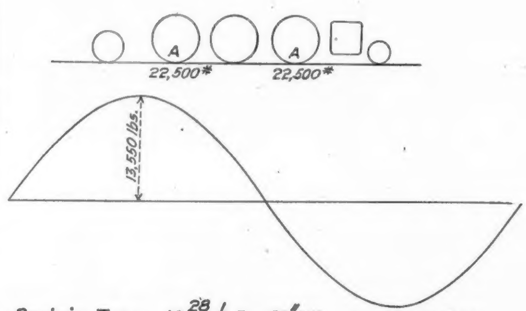
box pulled forward. As will be seen, the forces from both right and left-hand cylinders throw the right-hand box back.

In Fig. 2 the left-hand crank is passing the forward dead center. At this point the left-hand box is thrown from front to back of the pedestal, but as the right-hand cylinder is pushing the axle backward it tends to throw the left-hand box forward and thus counteracts to some extent the pounding of this box against the frame.

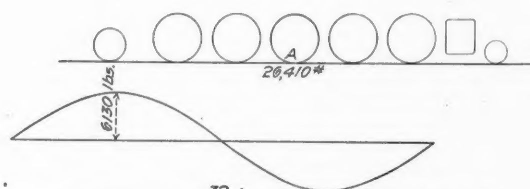
In Figs. 3 and 4 the right and left cranks are shown passing the back dead center. The effects are similar to those shown in Figs. 1 and 2, with the forces acting in the opposite directions. Although the direction of the forces is changed, the right-hand box is acted on by the combined forces while the left box is acted on by the opposed forces. It is thus seen that whenever the right crank throws the right box from one side of the pedestal to the other, the left crank increases the effect of the blow, but when the left crank throws the left-hand box from one side of the pedestal



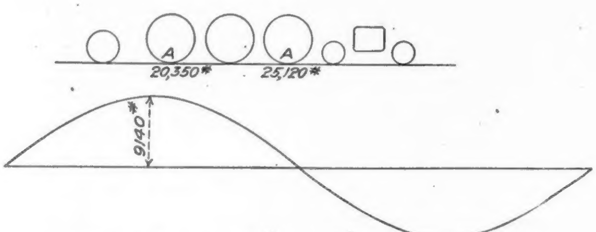

*Prairie Type. 10 $\frac{28}{50}$ $\frac{1}{4}$ D. 79" Wheels. 70 M.P.H.*



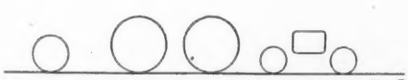

*Prairie Type. 10 $\frac{28}{50}$ $\frac{1}{4}$ D. 69" Wheels. 60 M.P.H.*




*Santa Fe Type. 14 $\frac{32}{58}$ $\frac{1}{4}$ F. 57" Wheels. 25 M.P.H.*




*Pacific Type. 12-38$\frac{1}{4}$ D. 79" Wheels. 70 M.P.H.*



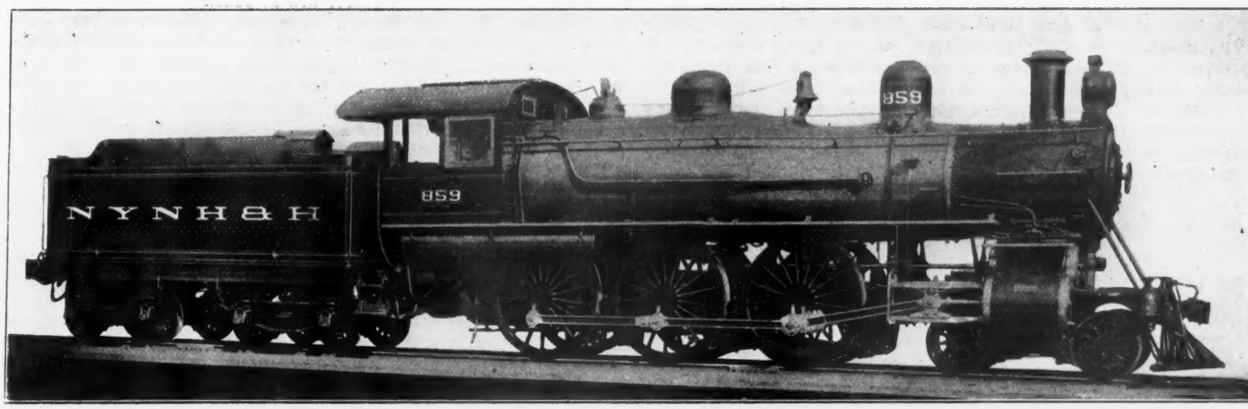
*Balanced Compound Atlantic Type. 10 $\frac{24}{44}$ $\frac{1}{4}$ C. 73" Wheels. No Disturbing Effect from Counterbalance.*

**Vertical Throw of Counterbalance Excess.**

to the other, the right-hand crank tends to reduce the effect of the blow. With excessive play of the boxes in the pedestals this pounding often sets up stresses which when added to the other stresses produce a sufficient resultant to cause a breakage of the right-hand frame.

It is obvious that a balanced compound engine with pistons moving in opposite directions should be free from failures of this kind.

These engines have met with most favor for passenger service when the greater necessity for perfect balance exists. It has been shown by experiment that a balanced engine does not affect a bridge



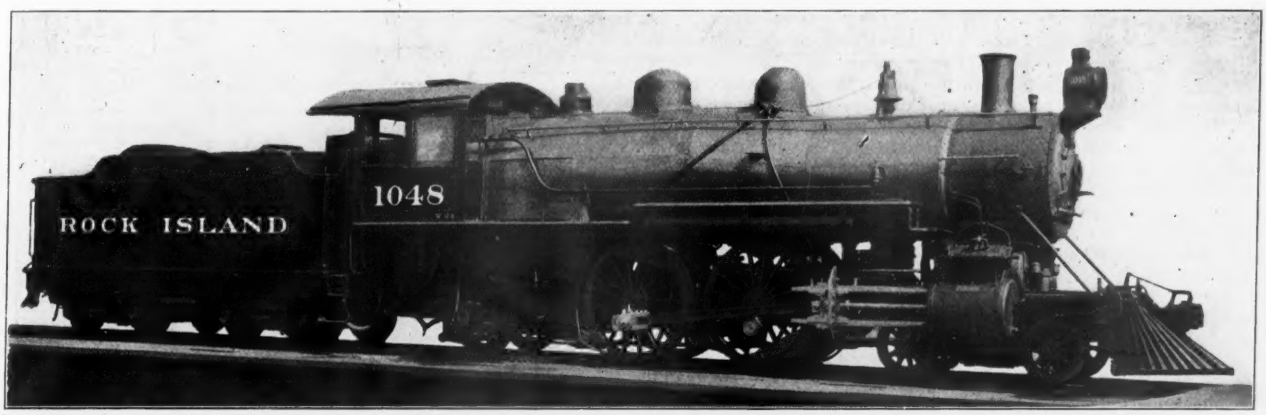

80-Ton, Ten-Wheel Vauclain Balanced Compound.

span any more than a car of equal weight, nor is it possible to determine the position of the balance when passing over the span. Engineers of the Maintenance of Way Department recognize this feature by rating these engines on the same basis as single-expansion engines of 20 per cent. less weight in all tables and charts of allowable wheel base.

The perfect balancing of the balanced compound type of engine recommends it particularly for passenger service, but its value in this service is enhanced by greater speed which it is able to maintain because of the wider port opening both during the period of exhaust and admission. This difference is graphically shown in the diagrams. It will be noted that the maximum port opening of the single expansion engine is ⅜ in. in comparison with ⅝ in. for the compound locomotive, and there is about the same relative difference in the exhaust opening. When we consider the great volume of steam which passes through a locomotive cylinder in an hour the advantage of the greater port opening following the use of four in place of two cylinders is apparent, as a modern high-speed locomotive consumes from 50,000 to 75,000 cubic feet of steam at 190 lbs. pressure per hour. It is a problem worthy of serious consideration to get this immense volume of steam into a cylinder, but a much more serious one to get it out again without undue back pressure, as the volume will have increased to 300,000 to 450,000 cubic feet. The effect of the larger port opening is shown in diagram 1,958, which shows a falling off in horse-power of the single expansion engine as the speed increases, but that the compound shows an increase in horse-power with each increase in speed. The economy resulting from compounding is best illustrated by the well-known water rate diagrams. The diagram was plotted from tests in freight service and not quite the same economy can be expected in passenger traffic.

The engines have been subjected to a number of service tests, the most recent being on the C., R. I. & P. The results of seven tests of a compound in comparison with a similar number of a single expansion engine of the same type and size showed the single expansion engine used 29.3 per cent. more coal and 33.0 per cent. more water than the compound in slow freight service. The Santa Fe has made some remarkable runs with them hauling 17-car passenger trains out of Kansas City. The C., B. & Q. is hauling 13-car passenger trains up the McCook-Akron grade with an Atlantic type balanced compound, whereas a large Pacific type single expansion engine tried the run without success.

These engines are the result of an evolution and they stand today as the highest type which men who have devoted their energies to the problem have been able to produce. They are meeting the conditions for which they were designed and the next decade will undoubtedly see their rapid increase in favor. They present one of the best solutions for the demands for heavy power and high-speed, and they have passed their experimental stage and are now in the hands of their critics.




100-Ton, Atlantic Type Vauclain Balanced Compound.


Pacific Type Vauclain Balanced Compound.

### Chesapeake & Ohio Double Tracking.

The great increase during the last two or three years in the traffic—particularly coal traffic—of the Chesapeake & Ohio has made necessary extensive improvements to the line. For a number of years double-tracking has been under way, and at present is being especially actively prosecuted. The following statement published on May 4th in the Railroad Construction column of the *Railroad Gazette* shows the extent of the work:

| | Miles. |
|---|---|
| Placed in operation since July 1, 1905: | |
| Winifrede to Charleston | 13.0 |
| Russell to Riverton | 7.8 |
| Total | 20.8 |
| Under Construction: | |
| Allegheny to Tuckahoe | 1.5 |
| Charleston to St. Albans | 11.9 |
| Dayton to Silver Grove | 5.7 |
| Walker to Norge | 11.2 |
| Sewell Bridge | 0.8 |
| Lynchburg to Tyree | 3.2 |
| Total | 34.3 |
| Contracts Just Let: | |
| Grove to Morrison | 15.8 |
| Norge to Williamsburg | 7.6 |
| Greenway to Riverville | 9.0 |
| Jerry's Run to Lewis Tunnel | 1.1 |
| Hawk's Nest to Cotton Hill | 1.2 |
| Gauley to Mt. Carbon | 8.4 |
| Maysville to Lawrence Creek | 5.4 |
| St. Albans to Barboursville | 29.2 |
| Total | 77.7 |
| Bids Wanted: | |
| Concord to Crooked Creek | 10.3 |
| Total of last two groups | 88.0 |

On the 50 miles of double track to be finished this year there are several miles of high solid rock cutting, one of the embankments being 215 ft. high. From Lewis to Barboursville, West Virginia, the double-tracking is accompanied with a change of the line of the road through a heavy region and a reduction of grades to $^3/_{10}$ of 1 per cent. and the elimination of all curvature sharper than 3 degrees.

Of the whole length of the main line from Newport News to Cincinnati, 192 miles consists of two parallel roads between Richmond and Clifton Forge; one a continuance of the low grade through freight route; the other used for through passenger business. This much, therefore, of the through route may be said to have the advantages of a double track with the additional advantage of commanding the local traffic of separated sections of country. In a somewhat similar way, when the 88 miles of new double track for which contracts have just been let or bids are wanted mentioned in the statement are completed, there will be brought into use by means of bridging New River 11 miles of parallel line already built on the opposite bank of the river, making two tracks that will be used for through business under double track methods. When the 88 miles of new work is done, the situation will be that the main stem of the Chesapeake & Ohio from Newport News to Cincinnati, 655 miles, will consist of 343 miles of straight double track, 203 miles of parallel roads, affording equivalent advantages to double track and something more, and 109 miles of single track (not paralleled). The double track is not continuous, but including the parallel roads mentioned, it will be almost so on completion of the work in progress.

For this information we are indebted to Mr. Decatur Axtell, Vice-President, and Mr. Henry Pierce, Engineer of Construction.

### New York Central Electric Locomotives.

BY REGINALD GORDON.

For the electrical operation of through trains of the New York Central between Grand Central Station and Croton, N. Y., 35 electric locomotives are now being built by the General Electric Company and the American Locomotive Company at their Schenectady shops. The first electric locomotive, New York Central No. 6,000, shown in Fig. 1, and brought out about 18 months ago, has been given a thorough test since it came from the builders, and its performance has been so satisfactory that in those which are being built the original design has been modified only in details. A general description of locomotive No. 6,000 was published in the *Railroad Gazette*, June 3, 1904, and Nov. 18, 1904, and the account of a series of speed and acceleration tests with a 500-ton train in comparison with a Pacific type New York Central steam locomotive was published May 26, 1905. As these new electric locomotives will be put in regular service in a few months, a somewhat more detailed description of them is presented herewith. The locomotive as shown by Figs. 1 and 2 is mounted on four driving axles and has a two wheel pony truck at each end. It is propelled by four gearless motors, shown in Figs. 7 and 8, an armature being secured on each driving axle; and the current for the motors being obtained through shoes sliding on a third rail. There is also a trolley on top of the locomotive to make contact with an overhead wire in places such as road crossings where it is not practicable to have a third rail. While the armature is secured to the driving axle, the field coils of the motor are attached to transverse castings that connect the side frames. The cab, mounted on top of the frames, contains the controllers, rheostats, reversing and main switches, air compressor, boiler for train heating, air-brake apparatus, ammeters, etc., necessary for the operation of the locomotive, and is not only spacious, but so arranged that all appliances, both electric and pneumatic, are accessible for inspection and repairs. (See Figs. 3 and 4.)

The side frames are of cast-steel, locomotive type, with outside bearings for the driving axles, and have the boxes fitted in pedestal jaws in the usual manner. The end frames or bumpers are heavy steel castings (Fig. 5) bolted to the side frames and having pockets cast in them for the coupler drawbar and the platform side springs, as at each end a standard Gould platform is fitted to match that on a passenger car. To provide lateral stiffness, as well as to support the field magnets of the motors, there are five transverse steel castings, or crossties (Fig. 6), fitted and bolted to the side frames and having the field magnet cores cast

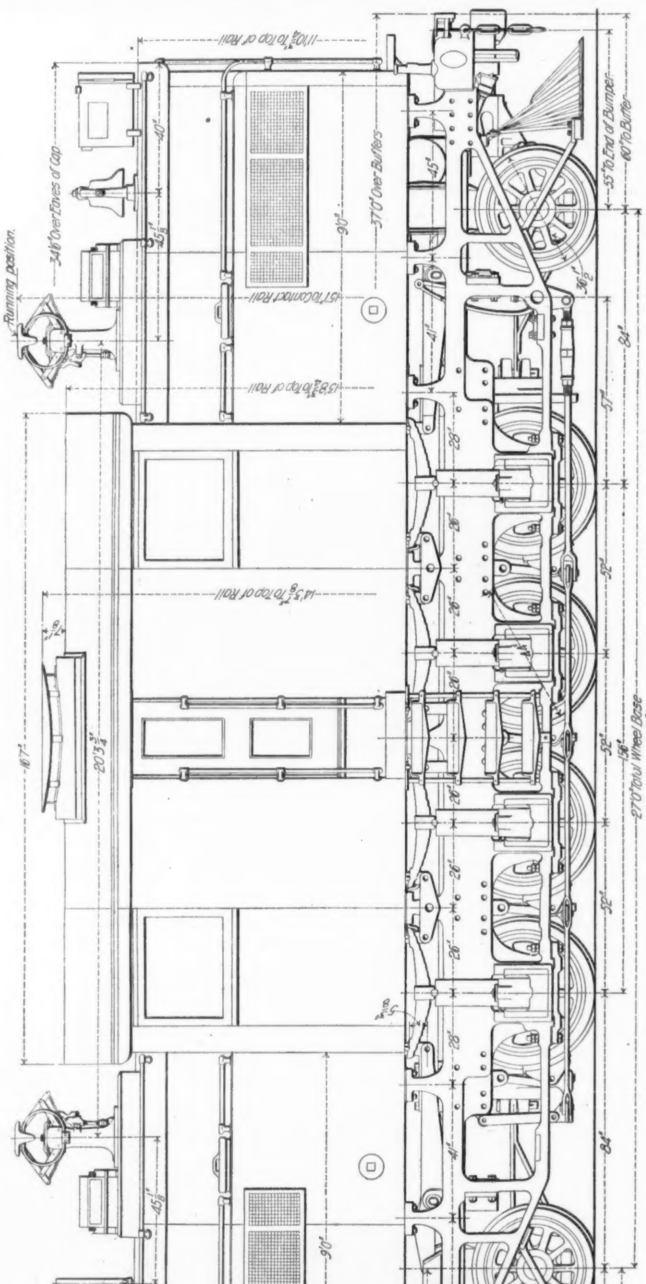


Fig. 2—Side Elevation.

with them. Above the crossties two longitudinal steel pieces of about 36 sq. in. cross-section are secured, forming not only part of the magnetic circuit of the motors, but being so located with reference to the center line of the locomotive that they cause a uniform distribution of weight, since the motors are slightly offset from the center line of the whole machine.

The springs and equalizing beams are placed above the frames, a half elliptic spring resting by means of a saddle on top of each driving box; and the first and second drivers reckoning from either end being equalized together and with the pony truck at that end. There is this difference, however, in the equalization of weight at the two ends, and partially shown in Fig. 12, that at one end the equalizers between the driving springs and the truck center pin are fulcrumed on short links bolted to the frame cross-tie, while at the other end the two equalizers are themselves connected by a short, transverse equalizer, thus forming a system that gives a three-point support for the locomotive. As the wear on the driving boxes will be more uniform than on those of a steam locomotive, no wedges are necessary, and the pedestal jaws are made parallel and have a shoe between box and pedestal on each side of the box. The driving axles have no end collars, all end thrust being taken between a bronze hub plate and the inside face of the box. The driving wheels shown in Fig. 9 are 44 in. diameter, the tires being held by retaining rings bolted on.

The motors (Figs. 7 and 8) are two-pole, direct-current, series wound, and rated at 550 h.p. each, thus furnishing a total of 2,200 h.p., and are built with ¼ in. clearance or air gap between armature and pole faces. They are built to run on a 50 per cent. over-

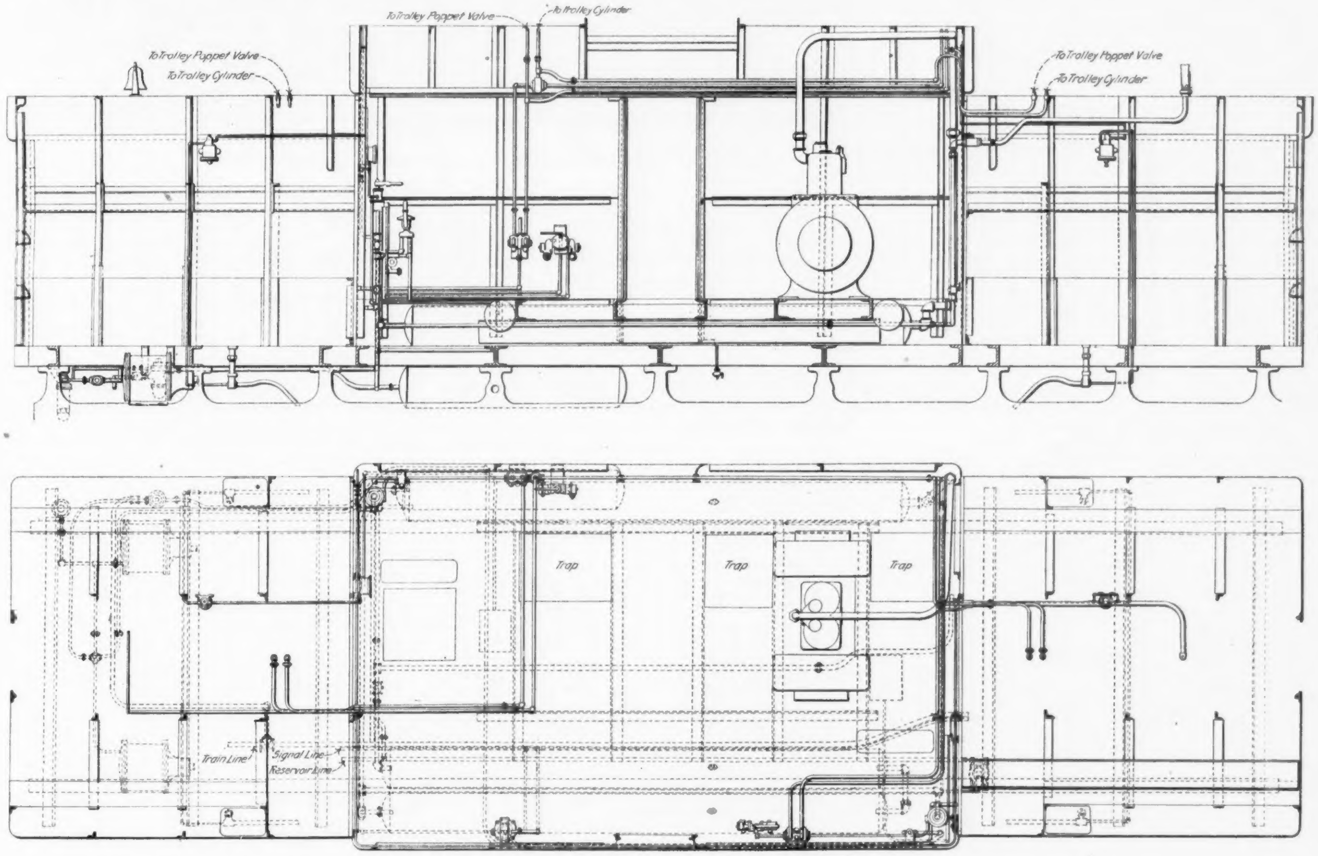



**Fig. 3—Plan and Longitudinal View of Air Piping.**

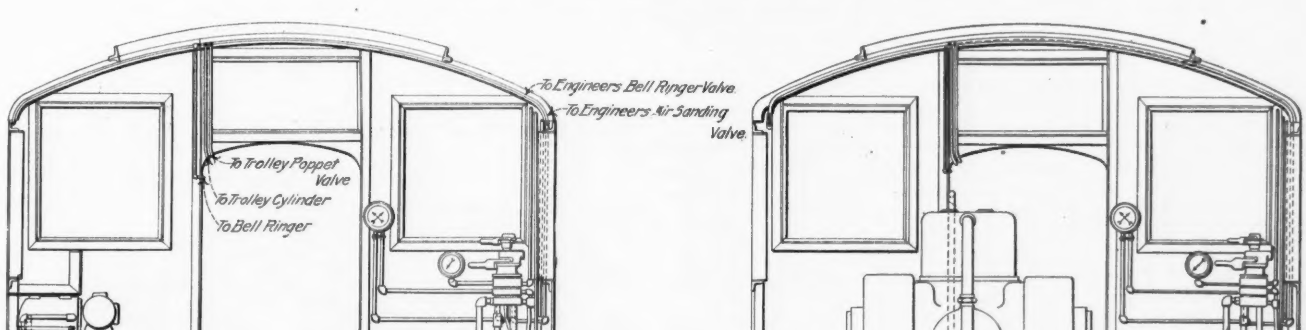



**Fig. 4—Air Brake and Auxiliary Piping; End Views.**

load for one hour with a rise of temperature not to exceed 75 deg. Fahr. As the armature is mounted nearer one side of the locomotive than the other, the steel bars on top of the frame forming part of the magnetic circuit are placed to one side of the central axis, as heretofore mentioned. The brush holders, which can be seen in Figs. 7 and 8, are mounted on insulated supports secured to a lug cast on the frame cross-ties, and are so arranged as to allow a vertical adjustment of 1¼ in. The motor field coils are rectangular in shape and held in place by bolts passing through the transoms of the frame. They are armored by a heavy brass casing outside of the windings, and over all a thick coating of asphalt paint is applied to exclude dust and moisture. As there are four motors, each with two field magnets, and five transverse frame castings to which the field coils are attached, the second, third and fourth transoms are cast with a magnet core on each face, while the first and fifth have

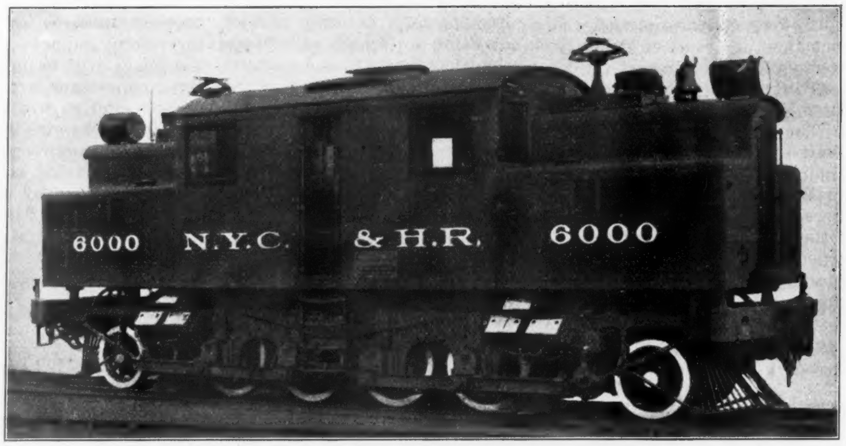



Fig. 1—Experimental Locomotive Built in 1904.

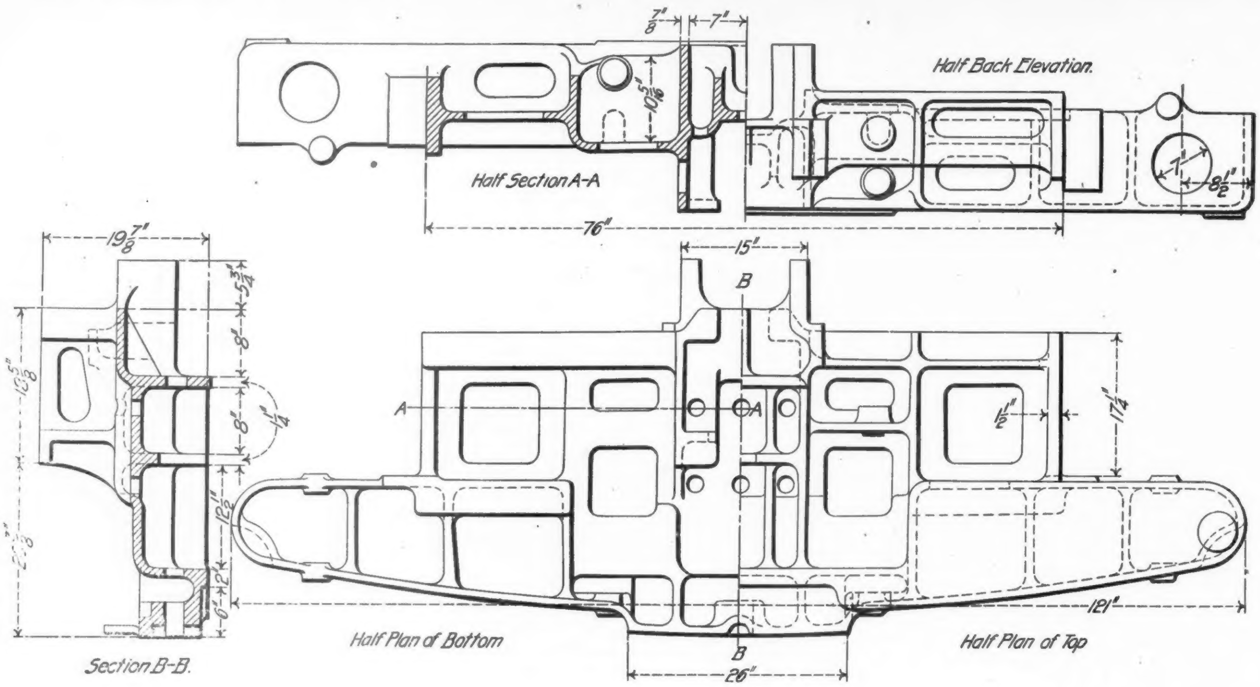



Fig. 5—End Frame.

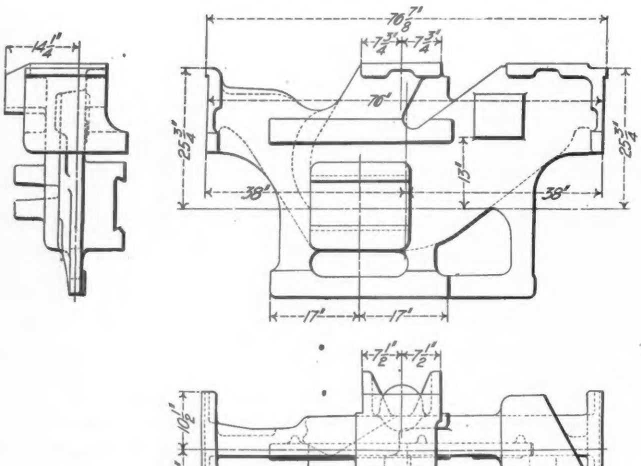


Fig. 6—End Transom.

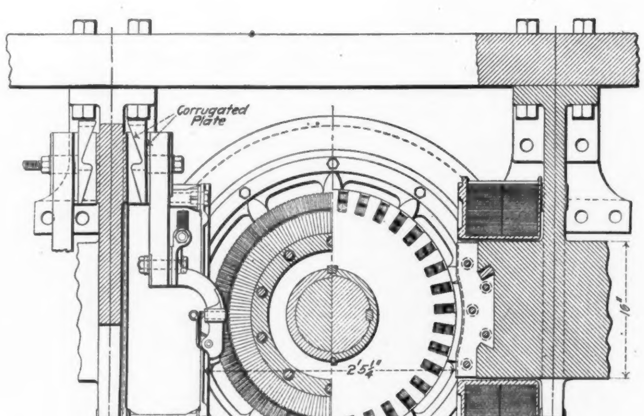



Fig. 7—Motor; Transverse Section.

a magnet core on one face and a lug on the other for the pin of the truck radius bar. The laminated pole faces of the field magnets, made up of thin soft iron plates, are dovetailed into the end of the magnet cores and held in position by the field coils.

For the control of 2,000 to 2,500 h.p. developed by such a locomotive as this, and to enable two such machines to be run together if necessary, the Sprague General Electric multiple unit system of control has been adopted. Naturally, the safe and reliable operation and application of such an amount of energy necessitates the use of large auxiliary apparatus, and for this purpose the cab is none too large. The central portion of the cab (Figs. 2, 3 and 4,) is occupied by the motorman's controller and air-brake valve, one at each end, the air compressor and train heating boiler; also ammeters and voltmeters, air gages, whistle cord and electro-pneumatic switch for sander and bell ringer. From this central portion an aisle or alley leads to a door at either end, and on each side of the alley way are placed the rheostats and contactors for controlling the amount of electricity supplied to the motors. In the same locality there is also the main switch, by means of which the current from the third rail is connected to or disconnected from all the apparatus on the locomotive, and the reversing switch, for reversing the direction in which the motors will run. There are also small switches for turning on the headlights, lamps in the cab, sander and bell ringer, etc., etc. Referring now to the rheostats and contactors, it should be borne in mind that when a direct-current motor is to be started it must always have some electrical resistance in series with it to prevent an excessive rush of current through its coils, and which resistance is diminished or cut out as the motor gains speed. For four motors, each rated at 550 h.p. each, it can be readily understood that a set of resistances capable of absorbing a large amount of energy must be provided. These resistances, or rheostats, are flat grids made of cast-iron, mounted in strong cast-iron frames, from which, of course, they are insulated, and connected by heavy copper bus bars to the switches or contactors that correspond to notches on the motorman's controller. Cast-iron is used for the rheostats because it is strong, has a high specific resistance and can absorb enough energy to heat it to a dull red before any danger of short circuiting can occur; and since they are cast in the form of loops of flat, thin section, the rheostats have a large heat radiating surface in proportion to their mass. The current of electricity passing through any of the rheostats and the motors is varied in amount, or cut off by switches or contact surfaces called contactors, located above the rheostats in the cab. As it would be impracticable and dangerous to perform these functions in the controller directly operated by the motorman, his lever moves what is called a master controller, in which a small electric current, not more than nine amperes, by being made and broken at the various points on the controller cylinder, operates the magnets of the contactors, which thus make and break the currents to the motors. In starting a heavy train, this electric locomotive has developed a drawbar pull of 32,000 lbs., and the ammeter showed that the four motors were absorbing energy at the rate of 4,200 amperes, about 3,300 h.p.

The controller has three sets of notches on it, with which the lever, resembling a small throttle lever, engages as it is pulled back, that is towards the motorman. The first set connects all four

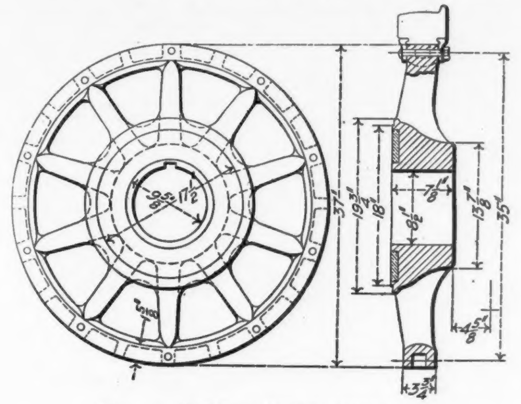


Fig. 9—Driving Wheel Center.

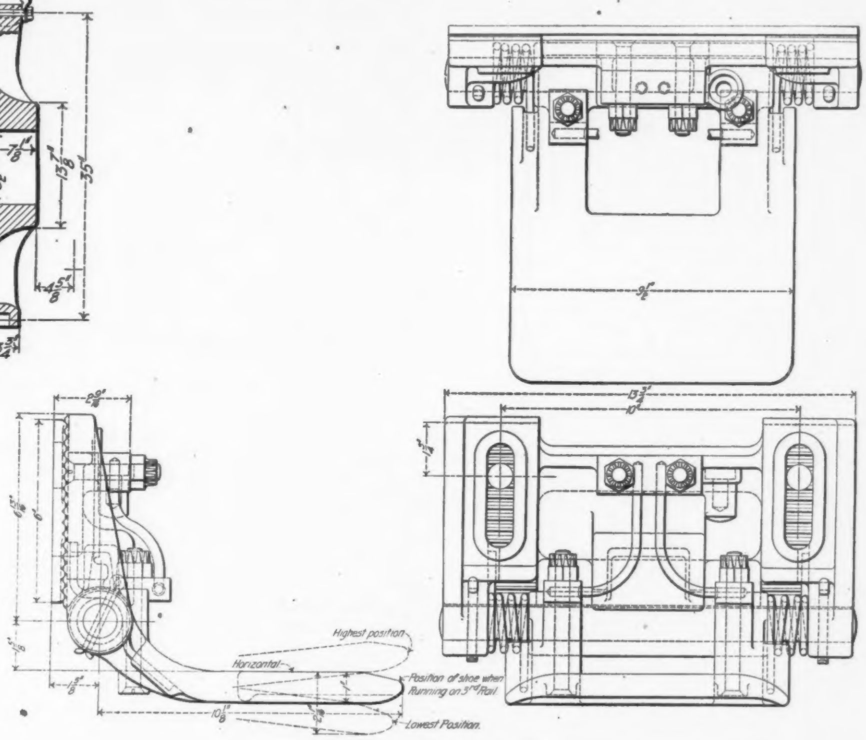



Fig. 10—Third Rail Shoe.

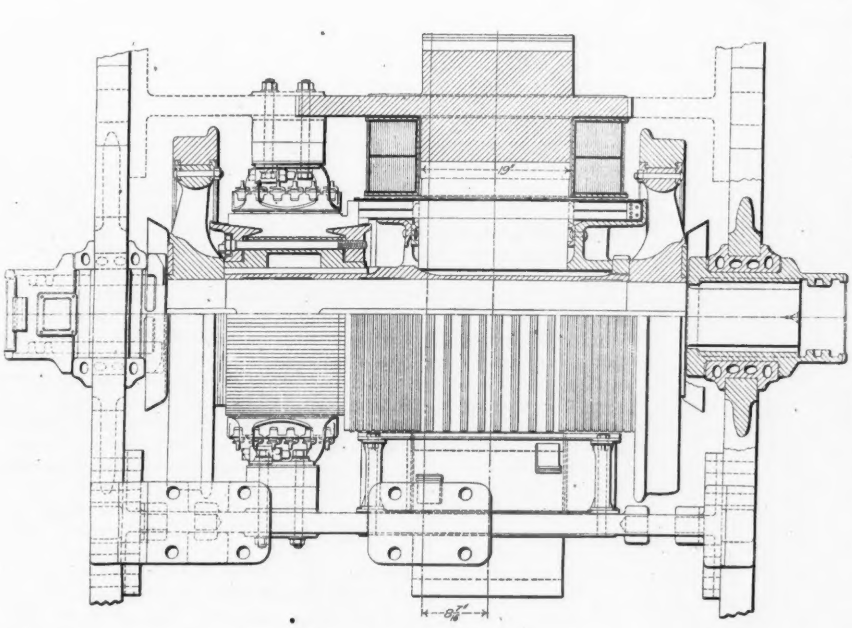


Fig. 8—Motor; Longitudinal Section.

motors in series and with the resistances which are gradually cut out as the controller handle is moved from notch to notch; the second controller position connects the motors in two pairs in series, the two series then being connected parallel; while the third position puts all four motors in parallel and gives the maximum power available. In order to prevent the motorman from cutting out resistance too rapidly, and so giving the motors an excessive amount of current before they get up to speed, an electro magnet is provided that locks the controller handle if more than a predetermined current for each position of the handle is exceeded.

The electric current is collected from the third rail by four shoes, one of which is shown in Fig. 10, which are in pairs, and spring supported from a longitudinal piece of wood that insulates them from the locomotive frame. The wooden piece is bolted to two brackets secured to the frame between the first driving box pedestal and the inclined bar of the frame. This is a modification of the design on the locomotive shown in Fig. 1, where it will be seen that the shoes were set farther from the ends of the frame and closer together. The shoes have a vertical play of about 2 in. to adapt them to make contact with either an under or overrunning third rail. As at highway crossings the third rail is continued as an overhead conductor, a pantagraph type of trolley is mounted on top of the locomotive and raised and lowered by air pressure controlled by an automatic electric control device.

For the air-brake and other pneumatic devices, a double-cylinder compressor driven by two General Electric 600-volt series motors is mounted in the cab. It is controlled by an automatic electric governor that starts or stops it at such times that the main reservoir pressure is maintained between 125 and 135 lbs. per square inch. This motor-driven compressor is shown in Figs. 3 and 4 as it stands in the cab, and in section by Fig. 11. It has two air cylinders, each 7¾ in. diameter by 8 in. stroke.

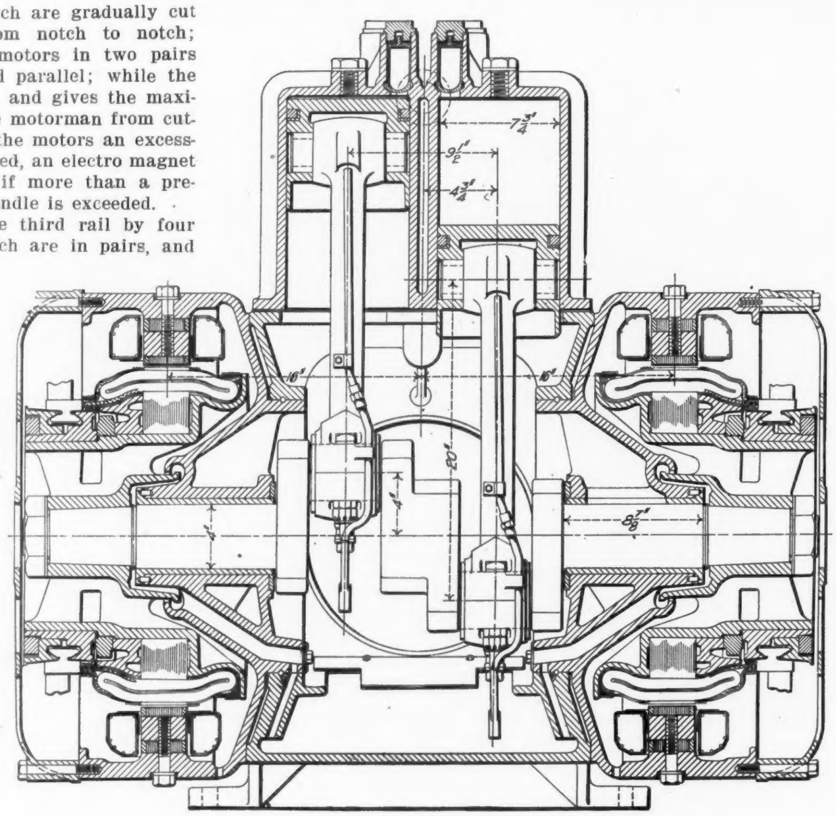


Fig. 11—Air Compressor.

This type of locomotive has proved itself capable of handling heavy, fast trains in a satisfactory manner; it starts easily, accelerates rapidly, and owing to the multiple unit system of control, a train may be double-headed by two of these engines. In addition to this, arrangements have been provided for controlling the air compressor of one locomotive from the other, and for supplying the main reservoir of one by the compressor of the other, should the occasion arise for doing so. The results of operation on the experimental track near Schenectady have shown that for the first 25,000 miles run, the cost for repairs and maintenance has been 1.7 cents per engine mile. The locomotive is now undergoing its second 25,000 mile test.

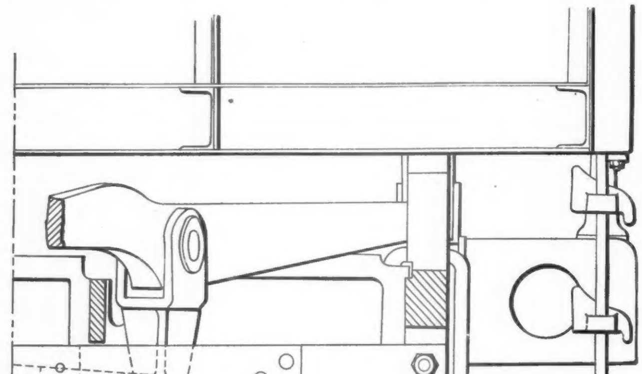


Fig. 12—Cross Equalization System at One End.

One of the most noticeable things about these large electric engines is their steadiness at high speeds. This is apparent at once by anyone who has ever ridden on a steam locomotive. There is no "nosing" or "hunting," and they take curves with the greatest ease. The runners of the steam locomotives find it difficult to realize the speed that can be attained and the load that can be pulled by the "electrics." The mystery that always surrounds anything operated by electricity only sharpens the curiosity of these men; and they appear to be making every effort to equip themselves to be able to understand driving these new machines.

A table of weights and dimensions is added:

| | |
|---|---|
| Total weight | 190,000 lbs. |
| Weight on driving wheels | 140,000 " |
| Total length of locomotive | 37 ft. |
| Total wheel base | 27 " |
| Rigid wheel base | 13 " |
| Diameter of driving wheels | 44 in. |
| Diameter of truck wheels | 36½ " |

## Gasolene Motor Cars.

BY W. R. M'KEEN, JR.
Superintendent Motive Power and Machinery, Union Pacific Railroad.

Although we see large flocks of sheep and herds of cattle with their main supply of water entirely dependent upon the successful performance from hour to hour of a gasolene engine; although we see large coaling and pumping stations on important trunk line railroads, the uninterrupted service of which is dependent upon the performance of the gasolene engine; and see automobile engines running sometimes eight or nine months, without any attention save oiling, we know that the development of the internal explosion engine is in its infancy; that our experience with these engines is more or less limited, as compared with other means of developing power, and that the future use of these engines will be enormous as compared with the present day.

The introduction of the gasolene engine as a transportation power for motor cars fills a long-felt want by all railroads, namely, a self-propelled car, permitting of frequent service, at a reasonable cost to operate, on an established steam railroad system, and afford the same frequency of service as given by the electric lines.

In picking up passengers on branch lines and in delivering passengers at connecting points for through trains, the service of these motor cars will be exceedingly lucrative. The matter of giving the branch line patrons of any steam road increased service, with

more frequent trips per diem, is very much appreciated by the local community, and their good will is beneficial.

The present Union Pacific motor cars, with the limited horsepower engines, are particularly adapted to branch line service; they maintain readily a speed of 40 miles an hour, and can develop this speed hour after hour at a minimum cost. These cars can average easily three miles per gallon of gasolene, and frequently making four, and in some cases five, miles per gallon. The cost of operating these cars is largely dependent upon local conditions and methods of operating. It is safe to say that the performance will not be less than three miles per gallon; therefore, if gasolene can be purchased (in wholesale lots) at 9 cents a gallon, the cost for fuel would be 3 cents per mile.

With an experienced force to take care of repairs, and operators of reasonable skill, the cost of repairs to these cars will be in the neighborhood of 3 to 5 cents per mile (estimated). It is necessary, of course, to have one man, called the "motorman," in the engine room to operate the car. This man should be held responsible for the entire car, the movement of same, and light repairs to machinery, as well as the adjustments on the gasolene engine. On lines through sparsely settled country, an assistant to take up the tickets, shut the doors and assist motorman generally would be all that is necessary. In other places it might be necessary to have a conductor, as on interurban lines, who would take up tickets, use telephone (to receive orders, etc.) and work with the motorman. The cost of operating cars is largely dependent upon the wages paid these men.

It is of the utmost importance that the motorman be made the man in charge of the car, and that his wages should be commensurate with his duties, since it is more important to have men of ability in the engine room than in the passenger end of car.

The first gasolene motor car built by the Union Pacific Railroad, and designated as motor car No. 1, was turned out of the company's Omaha shop in March, 1905. This car, built to the railroad company's designs, was essentially an experimental car, and demonstrated in tests and regular service the practicability of gasolene power as a transportation medium.

Motor car No. 1 is 31 ft. long, mounted on a single four-wheel truck, wheels being 42 in. in diameter. The weight of the car is a trifle over 20 tons.

In testing, car No. 1 was coupled to two passenger cars, a standard mail car and a standard coach, totaling 112,000 lbs. in weight. These cars were successfully started and accelerated, both on a descending and on a one-third per cent. ascending grade, the motor thus starting a total load of 152,000 lbs.

Pulling the standard mail car, weighing 52,000 lbs., motor car No. 1 ascended a 1.6 per cent. grade at a rate of 11 miles per hour, the total load pulled being 92,000 lbs. In another test on a coal chute trestle, motor car No. 1 easily ascended a grade of 7.8 per cent., or about 400 ft. to the mile, the car being stopped and started repeatedly on the grade.

On April 2, 1905, the car was given its initial long-distance test, and made the round trip between Omaha and Valley, Neb., on the main line of the Union Pacific Railroad, a total distance of 70 miles, when the schedule for passenger trains was easily maintained. Leaving Omaha April 16, 1905, car No. 1 made the trip entirely under its own power from Omaha, via Denver, to Portland, Ore., and return. Leaving Cheyenne, the ascent of Sherman Hill, the summit of the Rocky Mountains, was made, the 27 miles of steep grade being accomplished without difficulty. On August 21, 1905, motor car No. 1 went into regular service between Kearney and Callaway, Neb., distance 65 miles, making one round trip daily.

Motor car No. 2, the second Union Pacific gasolene motor car, is an all-steel car, and is the standard design for all cars built subsequent to car No. 1. This and subsequent cars have two four-wheel all-steel trucks; driving wheels are 42 in. in diameter, other wheels 33 in. Car No. 2 is 55 ft. long, with seating capacity of 57. Weight of car is 28 tons. This car embraces all the features of motor car construction in the way of ventilation, sanitation, heating, lighting, etc. On its initial long-distance test, September 14, 1905, the car averaged 37 miles per hour between Valley and Omaha, a distance of 35 miles. A maximum speed of 52 miles per hour was attained on this run.

On September 22 a second trip was made to Valley and an average speed of 39.4 miles per hour was made on the westbound trip. On the eastbound trip the car made the 25 miles from Valley to Gilmore in 30 minutes, or an average speed of 50 miles per hour. Several miles were covered in 57 seconds, or 63.2 miles per hour, and mile after mile was accomplished at better than a mile a minute.

Since October 6, 1905, motor car No. 2 has been in regular service between Kearney and Callaway, making one round trip, or 130 miles, daily.

Motor cars Nos. 3 and 4 are of the same general design and description as car No. 2, except that these cars have baggage compartment. Car No. 3 left Omaha November 10, 1905, making the trip under its own power to Houston, Texas, and is now in regular service on line of Southern Pacific Company between Houston and Galveston. Motor car No. 4, upon completion, made trip to the Chicago & Alton road under its own power, and was in service on that line out of Bloomington for several days under test. The car was afterwards in temporary service on the Kearney branch; then it was sent to Portland, Ore., under its own power, and is now in service on line of the Oregon Railroad & Navigation Co. out of that city.

Motor car No. 5 left Omaha January 12, and reached Los Angeles January 23, 1905, having made the entire trip under its own power. The run from Salt Lake to Los Angeles, a distance of 778 miles, was made in a little less than four days, running about eight hours per day. After being tested on various lines of the Southern Pacific Company out of Los Angeles, the car was placed in regular service.

Motor car No. 6, since February 6, 1906, has been in regular service on branch line of the Union Pacific between Leavenworth and Lawrence, Kan., making the round trip of 68 miles daily. Train consists of motor car No. 6 and trailer, and is operated on regular schedule, displacing a steam train formerly operated on this branch, consisting of locomotive, combination baggage, mail and express car and coach.

Motor car No. 7, which is the latest car turned out of the Omaha shop, is 55 ft. long; the engine room and operator's compartment occupies 12 ft. 8 in. at front end of car, and the passenger compartment is 41 ft. 10⅝ in. long, with a total seating capacity of 75. The seats are built-up veneered wood seats, with seating capacity of three people each. The semi-circular seat at rear of car has seating capacity of 11. While this car is of the same general design as previous cars, it embraces some new features. The square design of window has been done away with, and an air, water and dust proof round window sash substituted. This sash is similar to the porthole of a vessel, and keeps out all elements, which the double sash in the finest Pullman cars is unable to do. Car No. 7 has side entrances, the doors being located at center of car.

The roof of motor car No. 7 is 9 in. lower than in other motor cars, notwithstanding which the ventilation is entirely adequate. The roof of Car No. 2 is 15 in. lower than an ordinary passenger car, so that the roof of car No. 7 is 2 ft. lower than the ordinary passenger coach. The interior of this car is finished in English oak, and its weight is 58,000 lbs.

On April 4 motor car No. 7 made its first trial trip from Omaha to Valley, 35 miles, and return. This was for the purpose of limbering up the machinery, and no special time was made, on account of the large number of passenger and freight trains to be met; the car, however, made close meeting points, like any other train, always exceeding the orders. On this trip a maximum speed of 45 miles per hour was attained.

The car was given its first long-distance trial April 14 and 15. On April 14 it left Omaha as the second section of train No. 1, the "Overland Limited." The motor car gained on No. 1 to such an extent that at Fremont, 46 miles from Omaha, the motor car was held on the block six minutes. Car No. 7 ran as second No. 1 from Fremont to Grand Island, but owing to a heavy wind and meeting trains from this point on, some time was lost on No. 1's schedule. However, the total time of motor car from Omaha to Grand Island was 5 hrs. 12 min., with a delay of 40 min. on account of orders, meeting trains, etc., the actual running time for the 153.6 miles being 4 hrs. 32 min., or 34 miles per hour. There was no delay whatever on account of the motor car, and the machinery was in almost constant motion from Omaha to Grand Island.

On the return trip, April 15, a speed run was not attempted and car was delayed over three hours for orders, meeting, trains, etc., in addition to a slight delay on account of a hot bearing. The actual running time from Grand Island to Omaha was 4 hrs. 10 min., or 36.3 miles per hour. From Elkhorn to South Omaha, 24.3 miles, the distance was covered in 36 minutes, which is at the rate of 42 miles per hour. A maximum speed of 53 miles per hour was attained on this trip.

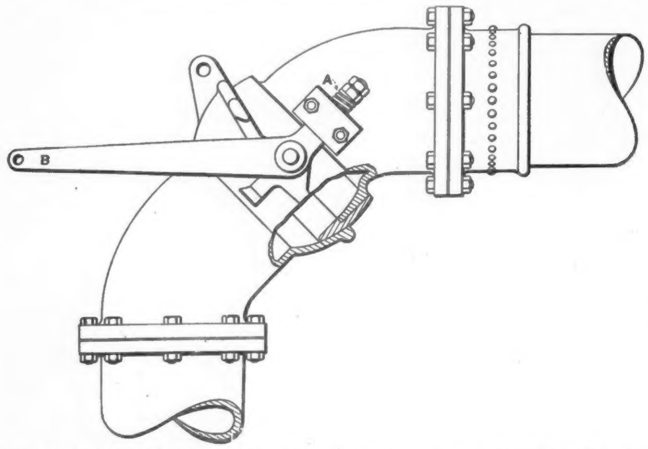
The same car left Omaha April 21 at 10 a. m., and ran under its own power to Grand Island, Neb., making the 153.6 miles in 8 hrs. 30 min. On April 22 it ran from Grand Island to Sterling, Colo., 276 miles, the trip being made in the daylight. Leaving Sterling the morning of April 23, it ran to Denver, 140 miles. After five days' service between Denver and Greeley, Colo., making a round trip of 103 miles daily, the car left Denver on the morning of May 1, and, running in daylight, reached Topeka, Kan., 573 miles away, at 7 p. m., May 3. The next day it ran from Topeka to Lawrence, Kan., and return; thence to Garrison, total distance 133 miles, and on May 5 ran from Garrison to Omaha, via the branch line, making the 209 miles by daylight.

On Friday, May 18, car No. 7 left Omaha for the trip to New York City, via the Chicago & North-Western and the Erie. Leaving Omaha at 7.07 a. m., May 18, the car reached Belle Plaine, Iowa, at 5:30 p. m., distance 239 miles; May 19 it left Belle Plaine at 7:25 a. m. and arrived at Chicago 6:30 p. m., distance 254 miles.

On May 20 it ran from Chicago to Lima, 218 miles, between 7:15 a. m. and 5:30 p. m.

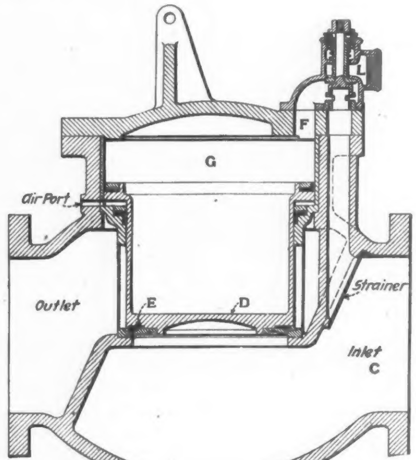
## Anderson Automatic Valve and Water Column.

In the self-adjusting water column made by the Golden-Anderson Valve Specialty Company, of Pittsburg, a flexible joint, whose construction is shown in the accompanying engraving, is used. The horizontal part of the pipe fits into a standpipe by means of a ball joint whose axis is at an angle of 45 deg. to the two parts, thus uniting them by an easy curve and securing a smoother flow of water than where a 90-deg. elbow is used. The two parts of the ball joint are held together by the stiff spring "A" on each side. This is, in turn, held down by a spring attached to the outer end of the lever "B." This lever also serves as a counterbalance for the horizontal pipe and spout. The counterbalance spring is encased in a piece of 3-in. wrought iron pipe with a plug at the top and bottom and a large bolt running through it, thus putting the spring in compression instead of in tension. By this arrangement there is protection against breakage or a drop of the spout, such as may happen where the springs are in tension.

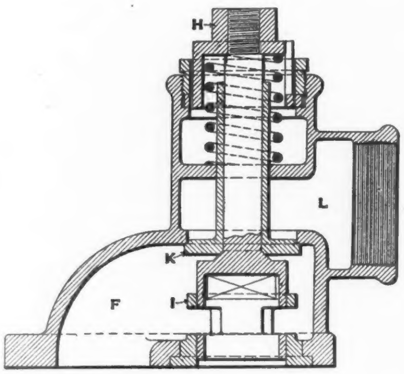



Self Adjusting Flexible Joint for Anderson Automatic Standpipe.

The bottom of the column is carried by a ball bearing, and has an automatic drain that can be thrown in or out of service at will simply by removing the shoe attached to the lug at the bottom of the column.



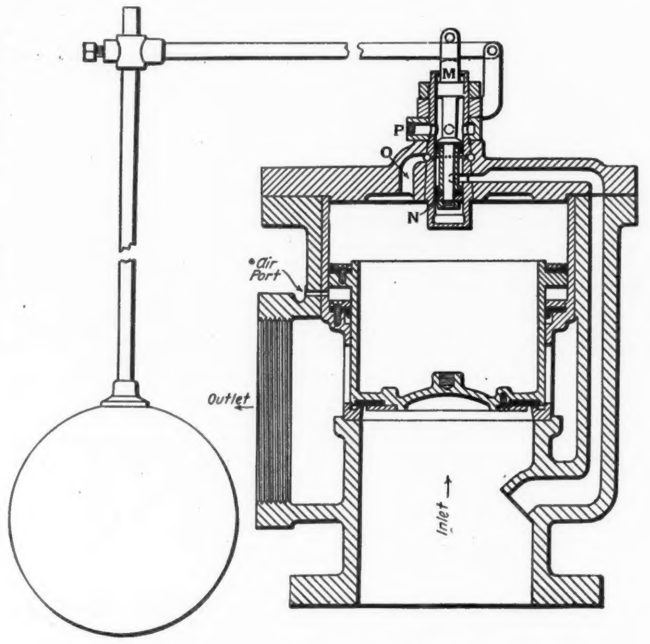

Section of the Anderson Automatic Standpipe Valve.




Section of Operating Valve of the Anderson Automatic Standpipe Valve.

The most important feature of the column is the valve shown in section in the two engravings herewith. Its construction and method of operation are as follows:

The whole is embraced in a substantial cast casing, with a connection to the source of supply at "C." The main or vertical part of the casing is bored to receive the differential piston "D," which has its larger diameter toward the top and with the two moving surfaces is packed with leather cup packings. When the valve is down in its normally closed position it rests on the soft packing "E," thus preventing leakage from the inlet to the outlet sides of the valve. Rising from the inlet side of the casing and protected by a strainer to prevent admission of foreign substances there is an auxiliary port that connects by way of the passage "F" with the space "G" above the differential piston. Under normal conditions this passage is open, and the water under its full head has free access to both sides of the piston. As the area of the top of the piston is the larger, it is forced down against its seat at the bottom and held closed by the pressure from above overbalancing that at the bottom. When the valve is to be opened for the flow of water, a movement of the hand lever, through its connections attached to the spindle at "H," pushes the valve "I" down to its seat. Just before it comes in contact the relief valve "K" is opened by being pushed down also, so that the water in the space "G" is free to escape to the waste by the outlet "L." The pressure above the differential piston being thus relieved, the pressure below forces it up and causes a flow out at the outlet through the valve. The piston is checked in its upward movement by choking the flow of water past the valve "K," and thus is prevented from slamming. At the same time it draws in air through the air port, and this serves a similar purpose when the piston comes down. It will thus be seen that the valve is automatic in its action, and that the stress on the operating lever to move the valves "I" and "K" is very slight. The adjustment of these two valves is made simply by turning the spindle "H" to the right or left.




Anderson Automatic Float Valve.

Another valve of the same character and working on the same principle is an automatic float valve. In this a float is made to open and close the passage from the source of supply to the space above the differential piston. When the float is down it rests on the spindle "M," to which the piston valve "N" is attached, and lowers it to such a point that water under pressure enters the central part between the cup packings and flows out through the holes in the side to the passage "O" leading to the space above the differential piston. As the float rises, it carries the piston valve with it until the port leading to the pressure main is cut off and the communication established between the passage "O" and the overflow "P," when, the pressure above the differential piston being relieved, the piston is forced up by the pressure below and communication between the inlet and outlet sides of the valve is established.

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A bitter cry for coal comes from Russia, where it has reached unheard of prices, while at the same time the coal-producers of the Donez district, the Pennsylvania of Russia, declare that they are near bankruptcy, not because they cannot produce their coal, still less because they cannot sell it, but simply because they cannot get it carried away. The railroads supply them with only 35 per cent. of the cars they ask for to fill orders. The authorities promise no relief until they get back the rolling stock diverted to the Siberian Railroad on account of the war, and before that time there will be much freezing.

## A Historic Locomotive.

BY C. H. CARUTHERS.

When His Royal H ghness the Prince of Wales, now King Edward VII. of Great Britain, visited America in 1860 his trip eastward from Pittsburg over the Pennsylvania Railroad was made in the only private car then owned by the company, original number 60, built some time earlier for J. Edgar Thomson, then President of the company; and locomotive number 166 was selected to haul the train over the entire distance. This engine had a short time before been almost entirely rebuilt at the Altoona shops and had been changed from a wood burner to a smoke-consuming coal-burner, having received an entirely new boiler with Gill & Co.'s patent firebox, and all the latest improvements of that period. It was one of the most complete and attractive, though not the most powerful, passenger engines then in service.

The principal dimensions of No. 166 were as follows: Cylinders, 16 in. by 20 in.; drivers, 66 in. diameter; firebox, 35 in. by 68 in.; weight on drivers, 33,200 lbs.; total weight, 55,200 lbs. The steam-chests were perculiarly set, with quite a sharp pitch transversely from the smoke-box as well as with the same longitudinal pitch as the cylinders, in order, it is said, to give greater length of ports without having the steam-chests extend too far beyond the outside of the cylinders.

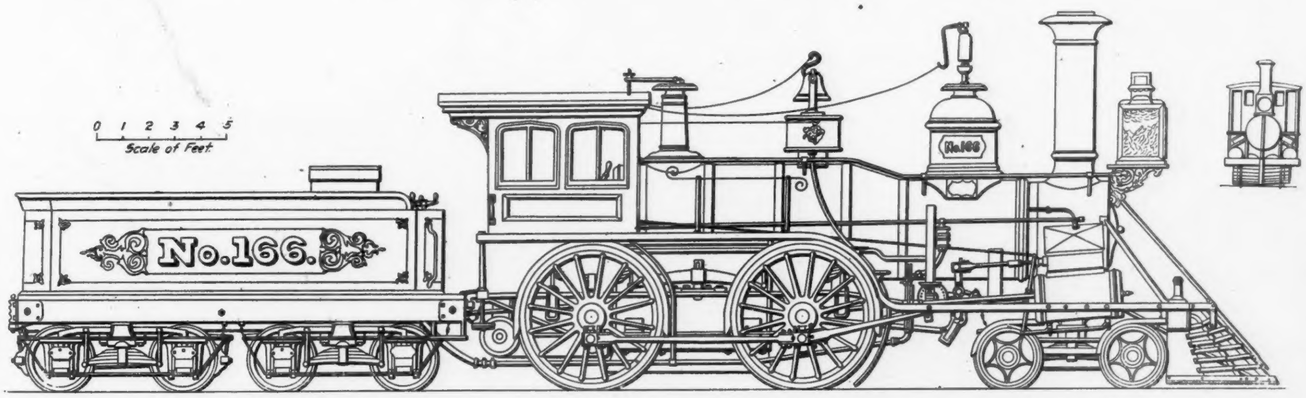
The painting was of the Altoona standard of that day; vermilion wheels, number plate, dome-base and centre panel of tender in vermilion; sand-box and outer portion of tender cistern, burnt umber; tender guard, chrome yellow; and all lettering and striping in gold leaf, with arabesques in colors. The frames were painted dark green without stripes. The cab was of black walnut, polished and varnished. The boiler, cylinders, steam-chests, dome and column for safety-valves, were jacketed with Russia iron; and all of these except the cylinder and steam chests, were fitted with bands, cornices and bases of polished brass. The driving wheels also had discs of polished brass, bearing the builder's name, attached to their centres.

Originally the engine was built at the Lancaster Locomotive Works of J. Brandt, in October, 1853, for the Columbia & Philadelphia Railroad, which belonged to the state of Pennsylvania, and was named Wheatland, after the homestead of the Hon. James Buchanan near Lancaster. It was then a wood-burner, with large balloon smokestack of the French and Baird type then in general use. The boiler was of the ordinary wagon-type pattern, with two 24 in. domes, one on the roof-sheet and close to the cab front, the other near the centre of the straight portion of the barrel. A round sandbox of polished brass with base and cornice of cast iron was placed between the domes, and the bell was about 30 in. behind the centre of the smokestack. Both domes were cased with polished brass. The trucks of the tender were of the Bissell inside journal type, nothing whatever being on the outside of the wheels, thus giving them the neat appearance of an engine truck. This arrangement was changed to the standard outside type at the rebuilding, but all other parts of the engine except the boiler and stack remained as originally built. In 1857 the Wheatland became the property of the Pennsylvania Railroad, through the purchase by that company of the state improvements, its name was dropped and the consecutive number of the company, 166, substituted.

This engine was again altered somewhat in appearance in 1866, six years after the Prince's trip, by the removal of the dome from the barrel to the crown-sheet in the position previously occupied by the safety-valve column; the placing of a round sandbox with base and cornice, on the former position of the dome; and the fastening of the bell to the base which had supported the square sandbox. The safety-valves were then put on the dome cover, and a balloon stack of J. P. Laird's design, which had been substituted for the straight one shown, in 1863, was retained in this last remodeling.

The engine continued thus without any further important change until consigned to the scrap heap in 1873.

When one remembers that this engine was built in 1853 the close resemblance of the valve-gear and many other parts to modern practice is especially noticeable.




Pennsylvania Railroad Locomotive Which Hauled the Train of the Prince of Wales in 1860.

## Management of Railroad Mechanical Department Employees.

BY J. E. MUHLFELD,
General Superintendent of Motive Power, Baltimore & Ohio.

The universal demand for safe, fast and regular train service at low rates, and the urgency for railroads to realize their great responsibility in the safeguarding of the lives and property entrusted to their care, as well as for the interests of the shareholders, brings with it the necessity for more thorough organization.

There are no employees in the general railroad service who are more concerned in the accomplishment of the desired transportation result than those engaged in the direct operation, care and maintenance of the motive power and rolling equipment. As the total wages paid to this class of employees, together with the cost for the material which they use, approximates one-half of the entire railroad operating expense, this item of the service, contributing as largely as it does to the general welfare or disorganization of the property, is entitled to the foremost consideration. The intelligent inspection, care, handling, distribution and use of the usually large amounts of expensive equipment and material entrusted to the manipulation and operation of mechanical department employees will result in net returns that can be duplicated in no other way.

The primary essential in a railroad organization is efficient men in control, and these can only be produced by the education and encouragement of the employees who constitute the rank and file.

Organization to be complete and effective must be composed of members of executive ability who have practical and progressive ideas and a strong and systematic control of generalties and details. Therefore, to insure competent labor an attractive apprenticeship system, which will give each such employee every opportunity for his moral, mental and physical training and development, must be provided.

In the promulgation of such an apprenticeship system young men who are willing to prepare themselves for and to follow locomotive and electrical engineering as a vocation should be entitled to the shop and road education, instruction and consideration necessary to enable them to intelligently and promptly learn the practical requirements for promotion, providing their qualifications and conduct may merit continued employment.

There is a universal desire for the benefit that can be derived from a higher educational standard of the mechanic and an apprenticeship system to accomplish this result, and to be truly valuable must combine the practical with the intellectual instruction. Furthermore, the result to be accomplished will depend largely upon the efforts put forth by the management, and for the successful inauguration of a given system such methods must be adopted as will best meet the different local conditions and individual interests, all of which will necessarily involve considerable labor and expense.

Given a young man, say 16 years of age, who has received a good home and common school education, and has health, energy, ambition and a desire to enter railroad mechanical department employment, he should be started to work as a wiper in a locomotive classified repair shop and advanced successively to regular appren-

ticeship work in the carpenter, pattern, foundry, blacksmith, boiler, machine and erecting shops, finishing his trade at the latter work. He should then be given the opportunity of inspecting and testing material and equipment and to do mechanic's work at engine houses and fire road locomotives.

During the apprenticeship course he should, on his own time, receive the benefit of the company's athletic and gymnastic associations, as well as of its educational facilities for mechanical drawing and practical mechanics. A system of progressive examinations should be in effect to determine how each young man's time has been occupied, and a record of these examinations should be kept in a proper manner.

After applying himself for five years at such employment a young man entering his majority should be in a position to decide as to his future special line of work and to qualify himself for a supervising position. But it is when the apprenticeship training has terminated and he must hammer out a place for himself in the world, that the care for his welfare must be given even more consideration by the management.

While a collegiate technical education is undoubtedly an advantage to those who will diligently apply themselves and fully embrace the opportunity offered by the information and knowledge gained in the use of books and instruments, it is not a necessity, and many college-bred men fail, because of their indisposition to go through the probationary period of practical mechanics and thereby learn how to secure the respect of and to supervise men, and convey information in a manner that will produce results, where the more practical and industrious man will succeed.

Even where a college course is afforded, the summer vacation periods should be spent in practical work under the regular, and not special, apprenticeship courses and rates of pay, in order to combine to the fullest extent the technical, theoretical and practical schooling with the actual shop operation and experience.

It is most desirable that railroad employees should receive instruction in railroad economics, such as organization, regulation, extension, improvement, condition, construction, operation, engineering and politics, from the school of experience, to properly equip them for administrative positions and to prepare them to handle details intelligently and to analyze difficult problems promptly and correctly. They should be taught to work with their own minds and to observe intelligently and not mechanically; to use books, reason clearly, become accurate, economize in time and money and to be mentally and morally honest and look facts squarely in the face.

Subordination is the first principle of good railroading, and, in connection with impartial and considerate treatment and a disposition on both sides to squarely meet the issues, will produce the greatest benefit from collective work. The young men should also be impressed with a respect for law and order, a love of chivalry and fairmindedness, with high purposes and ambitions.

Nothing will contribute more to railroad progress than a general characteristic of all engaged in the work to give the benefit of their experience to others and to receive from others and determine for themselves ideas which may be labor-saving. Such a desirable trait should be fostered and encouraged so that rapid advancement and improvement in railroad service and management may develop.

A systematic and departmental intercourse between employees of different departments should be stimulated, more especially as regards the use of technical and practical knowledge, with respect to design, construction and operation pertaining to the railroad as a whole, and a resolute effort should be made to secure brevity in the time required to make decisions. The necessary individual authority to act should be given and encouraged, while fiscal restrictions should be uniform and as simple as may be consistent with accuracy and safety and not interfere with the executive discretion.

In the adoption of methods and processes for labor and machine performance, each detail not absolutely indispensable should be eliminated, and the existence of any standard custom or practice should be no reason for its continuance when a better mode is offered.

Railroads, even more than industrial companies, require mechanical and electrical engineers of broad and sane intelligence, with a thorough grasp of general principles, and if competent men are to be secured and retained it will be necessary not only to give more consideration to rates of wage but also to provide the good treatment, careful instruction, counsel and vacations that competent men desire. Recognition should also be given to the deserving rank and file in filling new positions and those made vacant by regular promotion. The wages should be commensurate with the character and market value of the work performed and should be uniform for similar classes of service rendered in all departments. This will insure a strict enforcement of accounting for the property and the inauguration of practical, precise and intelligent methods for handling work to the best interest of the railroad as a whole rather than as a personal, divisional or departmental proposition.

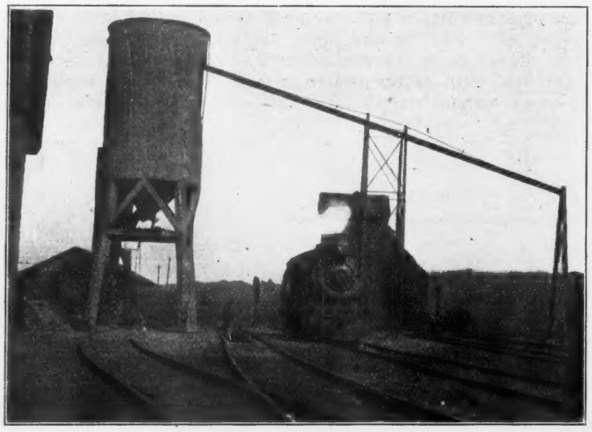
## Ash-Handling Plant of the Santa Fe at Argentine.

The yard at Argentine, Kan., across from Kansas City, is one of the largest on the Atchison, Topeka & Santa Fe, and the number of locomotives to be cared for approximates 150 daily. The ash-pit facilities for these locomotives heretofore have been the usual shovel-cleaned type. Some more expeditious and cheaper method became necessary, however, and a mechanical plant has recently been completed, a photographic view of which is shown herewith.

There are four concrete pits, each 135 ft. long, 3 ft. 6 in. wide, under as many tracks leading to the roundhouse. In the bottom of each pit is a track of 12-lb. rails, on which run four trucks with removable buckets. When a locomotive is to be cleaned, one or more of these trucks is run under the ash-pan and its contents dumped into the bucket.

Spanning the four pits, midway of their length, is an overhead I-beam track with a trolley and hoisting block. The trolley may be stopped over any one of the four pits, and the instant it stops the block will descend. The loaded bucket is conveyed to the top of the circular bin at one side of the tracks. This bin is built entirely of reinforced concrete, and is lined with brick. The construction obviates all danger from fire, and the brick lining takes up the wear on the bottom.

The bin has a capacity of 75 tons, and is hoppered to the center.



75-Ton Reinforced Concrete Cinder Bin, A. T. & S. F.

The accumulated cinders are dumped through a gate in the bin bottom into railroad cars on a track beneath. Several carloads are handled every 24 hours.

The plant is electrically operated, the trolley being moved by a 10-h.p. Lidgerwood electric hoist in a small frame house back of the bin. The inclined trolley track obviates the use of a locking trolley, thereby greatly simplifying the mechanism. The buckets dump into the bin automatically. The complete operation of securing, dumping and returning a bucket to the farthest pit requires about two minutes. One man operates the plant. One of the pit men attaches the block-hook to the bucket bail, of course. The plant is understood to be giving entire satisfaction. It was designed and built by Roberts & Schaefer Co., Chicago.

## Foreign Railroad Notes.

The American tramp must look out for his laurels in the matter of stealing rides. A Roumanian recently succeeded in lodging himself on the pipes underneath a dining-car of the Orient express at Costanza, on the Black Sea, said pipes affording a sort of shelf about 20 in. wide. He left this bed in Paris 53 hours later. It is remarked that at the end of the journey he was very dusty, hungry and thirsty, and possessed a capital amounting to 5 cents.

At the opening of the new railroad from the Red Sea at Port Sudan (a little north of Suakin) to the Nile at Berber, October 15, Lord Cromer congratulated the builders because they had been able to build the 325 miles through a waterless country in 14 months, and further because in that desert they had made it cost only £1,400,000, which is less than $21,000 a mile.

Various syndicates, native and foreign, have sought a concession for a railroad over the caravan route from Pekin northwest to the gate in the great wall at Kalgan, on the most direct route to Lake Balkan and Irkutsk, over which from time immemorial "caravan tea" has been carried to Siberia and Russia. The Chinese government has rejected them all, declaring that it will build this railroad itself, perhaps convinced by recent events that it will do well to keep in its own hands all approaches from adjacent countries.

# GENERAL NEWS SECTION

## NOTES.

The Cleveland, Cincinnati, Chicago & St. Louis has announced that it will not burden its conductors with bulletins describing lost or stolen tickets.

In the United States Court in Iowa, the Government has brought suit against the Chicago, Milwaukee & St. Paul for violations of the Safety Appliance law in using defective coupling or uncoupling apparatus on freight cars.

It is said that the Grand Trunk has abandoned its project of consolidating all the fast freight lines which run over its road. It appears that the Erie refused to be thus buried out of sight, and threatened to make a new alliance.

Vice-President W. C. Brown says that the New York Central Lines, meaning presumably all of the roads over which he exercises authority, moved during the month of May a larger number of loaded cars than ever before in one month, the total exceeding by 100,000 the total for the month of May, 1905.

Shipments of peaches have begun in Georgia for Northern cities. A railroad officer in Atlanta, said to be well informed, estimates that 5,700 carloads will be shipped from points in that State this year. The total number of cars sent out last year was 2,700. The largest crop hitherto was that of 1904, which amounted to 4,600 cars.

The State Railroad Commission of Kansas is issuing a new map of the state, and it is said that the number of towns shown on it is 100 less than on the last map published. This is due to the abandonment of small post offices in consequence of the introduction of rural free delivery, and also to the abandonment of some railroad stations, which is said to be due to the same cause.

The Illinois State Railroad Commission has finally issued a definite announcement in pursuance of its notice, promulgated about six months ago, threatening a general reduction in freight rates on the railroads of the state. The sixth class is reduced 10 per cent.; seventh class, 8 per cent.; wheat, grain, lumber, salt, coal and hogs, 10 per cent., and material reductions in the eighth, ninth and tenth classes.

In the United States District Court at Kansas City, June 11, the cases of the Government against the Chicago & Alton and the Chicago, Milwaukee & St. Paul for granting rebates on export shipments were dismissed, the District Attorney saying that he had become convinced that the railroads were not at fault in connection with the shipments on which the indictments were based. On June 12 four shippers—Cudahy & Co., Armour & Co., Swift & Co. and the Nelson Morris Packing Co.—were found guilty of accepting illegal rates. The jury deliberated one hour. On shipments of lard to Germany over the Chicago, Burlington & Quincy one of these shippers accepted a rate of 23 cents to the seaboard when the tariff was 35 cents. The offenses of the others were similar. Sentence was suspended until the completion of the trial of the Burlington road on charges based on the same transactions.

With the adoption of its summer time-table this week the New Haven road has restored the time of the through expresses which were made about 10 minutes slower last fall, and before, on account of the numerous delays at points where bridges were being renewed, and there are now running between New York and Boston every week day, each way, four trains which make the trip in five hours, and three which make it in 5 hrs., 30 min. Two of these last, the 12 o'clock and the 4 o'clock, go over the Boston & Albany, and the third, the 3 o'clock train, is quickened 40 minutes from its old time of 6 hrs., 10 min. This train runs by the Shore Line. Evidently, Mr. Mellen will never be so hardhearted as to compel a Boston passenger from New York to travel over the Boston & Albany unwillingly. The Fitchburg express now leaves New York at 3.53 p.m. and reaches Worcester at 8.24, or practically in the same time as that made by the Boston & Albany train leaving New York seven minutes later. The 9 a.m. train over the Boston & Albany now runs through in 6 hrs. and 1 min. The Mayflower Limited, the new 8 a.m., five-hour train, began business on Monday with three cars.

### 1,091 Baldwin Locomotives in Five Months.

In the first five months of this year the Baldwin Locomotive Works, Philadelphia, turned out 1,091 locomotives, or at the rate of 218 a month. In the first five months of 1905 the total production was 816 engines.

### The Supply Men's Vaudeville.

On Friday evening, June 15, the Entertainment Committee, of which A. L. Whipple, of the Curtain Supply Co., is Chairman, will give an amateur vaudeville performance to members and guests of the convention. The performance will be given in the Music Hall, on the steel pier, at 9 o'clock. All the talent is identified with the railroad supply business, as may be seen from the programme, which follows.

MASTER CAR BUILDERS' CONVENTION, ATLANTIC CITY, N. J.

*Supply Men's Amateur Vaudeville Performance.*

PROGRAMME.

Overture ........................................——— ———
Ensemble....................Some of the Railway Supply Men
Mr. Herbert Self, Soloist.
(By courtesy of Crandall Packing Co.)
Monologue ........................Miss Margaret Moir Currie
(By courtesy of Nathan Manufacturing Co.)
Illustrated Song ........ ............Mr. John H. Thomas
(By courtesy of Standard Paint Co.)

COLONEL CARTERET, V. C.
A Dramatic Sketch in One Act by Seth Cook Comstock.
CAST.
Col. the Hon. Sir Robt. Carteret, V.C.....Mr. Jacob Wendell, Jr.
Sir John Middleton, M.P............Mr. Evert Jansen Wendell.
Lieut. Robt. Carteret, 1st Hussars (Bobbie)...Mr. E. O. Power
Billings (Col. Carteret's Butler)..........Mr. Howard M. Peck
Scene:—Room in Colonel Carteret's House, London.
Time:—During the Boer War.
(Produced by courtesy of Wendell & MacDuffie.)

A Singer of Popular Songs ...............Mr. William Murray
(By courtesy of Jenkins Brothers.)
Character Stories .....................Mr. Charles C. Pierce
(By courtesy of General Electric Company.)
The Merry Minstrel .......................Mr. John Forsman
(By courtesy of Safety Car Heating & Lighting Co.
The Garlock Wizard...................Mr. E. Clinton Adams
"If you are satisfied with being mystified, you will be mystified until you are satisfied."
(By courtesy of the Garlock Packing Co.)
Informal Dancing.

Reeves American Band Orchestra.
Bowen R. Church, Leader.
Henry Frautzen, Accompanist.

### Southern Pacific General Offices.

The Southern Pacific has leased for a term of years nine floors of the 12-story James Flood building at the corner of Market and Powell streets, San Francisco, for its general offices. These floors will be fitted up at once for the accommodation of the departments that were burned out in the Merchants Exchange building. The city ticket office, formerly at 613 Market street, will also be in this building, and the city ticket agencies of a number of the eastern railroads will probably take quarters on the ground floor of the same building.

### Tracks in San Francisco.

An officer of the Ocean Shore writes that temporary tracks for removal of the debris from the burned district of San Francisco have been laid by the Ocean Shore, the Southern Pacific, the Atchison, Topeka & Santa Fe, and the United Railroads of San Francisco. These tracks cover the eastern district of the burned section. Storage bunkers will be located at convenient points along these tracks for receiving the discarded material, and to provide a rapid means for unloading cars. The four companies named above have united to carry out this work, and have put the several tracks and all equipment under one management, to be operated under the direction of the United Railroad which also directs the street car traffic. The discarded material is being used to fill in the Islais creek flats, the haul being about four miles. The amount to be moved is approximately 4,000,000 cubic yards. John B. Rogers, Chief Engineer of the Ocean Shore, is in charge of the work.

### Tinned Channel Pins.

A patent has recently been issued to Mr. E. W. Vogel, Signal Engineer of the Railroad Supply Co., Chicago, on a bonding or channel pin used in electrical signal construction, which is tinned or galvanized. Until recently channel pins, to prevent them from rusting and to insure a good contact, were copper plated. But often after a comparatively short time the bond wires would break off where they were in direct contact with channel pin and rail. The assumption was that this was due to ordinary processes or rusting. However, by careful investigations and tests, covering a long period of time, Mr. Vogel found that it was electrolysis which ate off these wires where they entered the rail. This was due to the fact that the copper plating of the channel pins and the zinc coating or galvanizing of the bond wire formed a combination with the damp atmosphere, making a miniature battery which would slowly and surely eat the bond wire in two. To overcome this it was necessary

to have the channel pin coated with a metal which is approximately of the same contact potential as the bond wire.

Tinned channel pins have now been in use for about two years, during which time it is said no cases of electrolysis have been found. The tinned channel pins have been recommended by the Railway Signal Association.

### Accident Record—With Variations.

The locomotive belonging to the Continental Coal Company, of Tulsa, Ind. Ter., was blown into fragments Friday afternoon (May 25) by dynamite, presumably placed on the track by property owners adjoining the railroad tracks, who are opposed to its operation. The mines of the company are located about two miles from Tulsa and are connected with the town by a single track of railroad. Owners of property which is crossed by the track opposed its building and there has been much dissatisfaction over it ever since. Although the engine was blown to fragments the crew was not injured. F. W. Kassner, cashier of the First National Bank of Tulsa, has been placed under arrest under a charge of having participated in the affair. There is great excitement at Tulsa, and the people are all arming themselves.—*Oklahoman, Oklahoma City.*

### The Effect of Sea Water on Concrete.

Mr. John Macaulay, General Manager of the Alexandra Docks & Railway, England, writes to the *Railway Gazette*, London, as follows: I have perused with considerable interest the article which apeared in your valuable paper on February 2, entitled "The Effect of Sea-Water on Concrete," and, with your kind permission, I should like to make a few remarks on certain aspects of the case which have not been touched upon.

The same omission occurs in all similar articles on this subject, and that is, the conditions under which the concrete was made prior to, and its condition at, the time it was immersed in the sea, are not stated.

As a rule concrete is used in two forms—either in large blocks moulded beforehand in the shape of artificial stone, or in blocks moulded *in situ* between tides.

With regard to the former, it takes but a short time, even for a layman inspecting a work where artificial stone blocks are made, to discover that the concrete is, generally, made very liquid and dropped into the moulding boxes without any attempt at punning, or solidifying sufficiently by ramming it in layers. The result is that a huge block is obtained in an extremely honeycombed condition, or the resulting state might aptly be described as "spongy."

It is generally known that excess of water has a tendency to kill cement and to prevent its being uniformly distributed in the body of the concrete. We also know that concrete which is not made fairly dry and vigorously rammed always contains cavities detrimental to the quality of the finished piece.

Blocks made as above described are allowed to set more or less rapidly, and in the case of the more voluminous blocks they are frequently used before the heart of the block is set at all. Those who have watched the lowering of such blocks under water will have probably noticed at times that for some hours after immersion bubbles of air were rising to the surface of the water producing that condition which justifies the term of "concrete sponge."

It will easily be perceived that in the case of blocks so moulded the sea-water, instead of being merely in contact with the skin of the concrete, penetrates into the interior of the blocks, where it sets up disintegration.

With regard to concrete blocks made *in situ*, the contractor is usually so preoccupied in getting as much concrete in a given space as he can between two tides, that in most instances the essential feature of punning in thin layers and welding them hard together is omitted, with the result again that sea-water is allowed to penetrate deeply into the concrete and begin its deleterious action before it has had time to crystallize or set hard.

Without doubting that some attention should be paid to the composition of the cement used, and that preference should be given to the quality which does not contain certain elements which have a tendency to be affected unfavorably by sea-water, more attention to the mechanical composition of the concrete is of even greater importance.

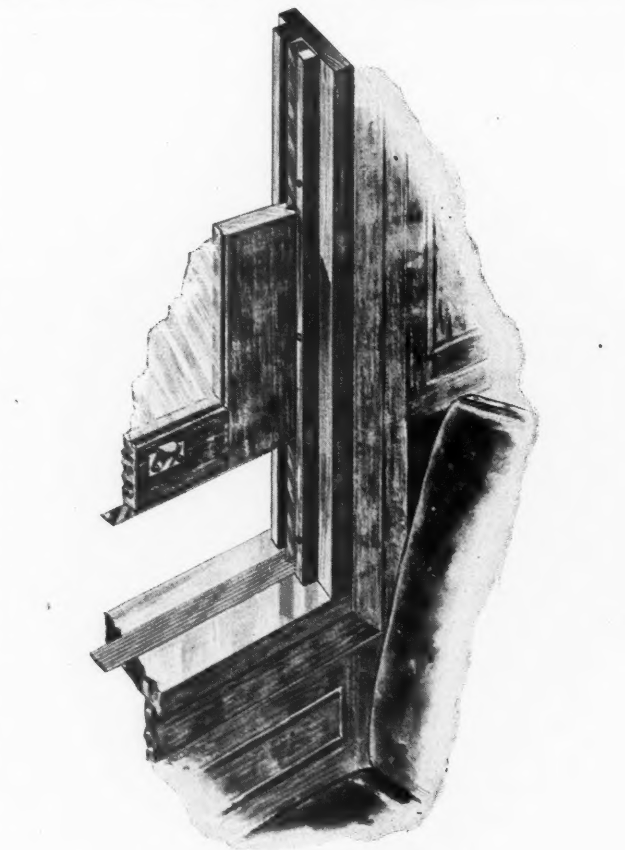
Everything depends upon the density of a block, and its imperviousness to the infiltration of sea-water can only be guaranteed by systematic ramming, which is best performed in thin layers, care being taken to secure a complete contact between successive layers.

In many heavy sea works which have given trouble, natural cement has sometimes been very largely used instead of good Portland cement.

In ferro-concrete work, where the concrete is used in comparatively small volumes, the most important members, namely, those which come in immediate contact with sea-water, such as piles, cylinders, etc., are prepared long before they are used in the works; they are also well punned. They are never used until the concrete has set perfectly, and, so far as experience goes in the particular kind of ferro-concrete work I have in mind—this, unfortunately, does not extend over a longer period than about eight years—it is stated that the works have not been found to be affected by sea-water, nor, in view of the great care taken with the preparation of the concrete, is it expected that they will suffer any deterioration from that cause.

### The Acme Metallic Weather-Strip.

The metallic weather-strip for passenger car windows here shown is intended to displace rubber weather-strips. Being practically indestructible, it will last the life of the car. It is simple in form and is invisible when the window is closed. It is easily applied, requiring no special nails or screws; instead, it is slipped under the window casing, its edge being notched around the screws holding same. As appears from the illustration, the weather-strip fits into a groove in the edge of the window sash. It is claimed to be dust and weather proof, does not rattle, and prevents windows



The Acme Metallic Weather-Strip.

from falling in dry weather or sticking in damp weather. The material is brass and the cost of application is no greater than for other good weather-strips. It may be applied to old equipment as cheaply as to new. The Acme Supply Co., Chicago, is the maker.

### The Farmer's Delight—The Interurban Railway.

1. He can go to town as easily as his neighbors, no matter how bad the weather.

2. He can have his produce taken to town and left with his grocer, in good weather or in bad, in busy season or in slack, and can have his grocer send back in same basket any groceries needed.

3. By putting in a spur he can load a car of grain, stock or fruit right on his farm without hauling it over long bad roads. He can buy a car of coal and have it delivered at his door.

4. By making arrangements to do so, can have the great metropolitan daily papers at his door, or near it every morning in time to read before breakfast.

5. Can go for the doctor, or take the sick one to the doctor, in comfort, without exposing him or her to the cold or bad weather, or to jolting over the roads.

6. Can visit towns a hundred miles away and return the same day with less trouble than he can now go to town to take the train.

7. Can sell off five or ten acre plats to parties for truck and fruit farms for three to five times as much per acre as his land will now bring.

8. Can turn all his farm into pasture, except 40 acres, and make twice as much producing milk, garden truck and small fruits which the electric car line will take to market every morning.

9. He can keep in close touch with the great world around

him, and enjoy the broadening influence which always accompany a more frequent intercourse. . . . .

10. His children can be given the advantages of better schooling with little, if any, added costs; can visit the larger places and there enjoy their libraries and other public institutions, and it does more than all else to reconcile the farmer's children to staying on the farm. He and his family will live longer . . . than those whose only method of getting to town is by hitching up old "Dobbin" and splashing through the mud and rain, and snow, and heat, and dust.

11. In Indiana, Ohio and Michigan, where there are 3,706 miles of interurban road, the land along these lines has increased in value all the way from $10 to $100 per acre. It will do the same in Kansas. Do you want from $1,600 to $16,000 added to the value of your quarter section? If you do write to the representatives of the Southern Kansas Electric Railway, Light & Power Co., Chanute, which is now building 160 miles of interurban road.—*Leavenworth (Kan.) Times.*

## TRADE CATALOGUES.

*Ventilating Apparatus, Blowers, Etc.*—A set of 10 publications has been received from the American Blower Co., Detroit, Mich., devoted to ventilating and blowing apparatus made by that company. Each bears a number. No. 189 is on "Steel Plate Fans." It is a 7 x 8¾, 82-page illustrated sectional catalogue on "A B C" fans for heating, ventilating and drying plants, forced and induced draft apparatus, etc. No. 190, on "Blowers," has 48 pages. No. 192 is a miniature on "A B C" "Dryers." No. 193, on "A B C" double enclosed high-speed self-oiling engines, Type E, is standard size, containing 11 pages. No. 194 on engines for small direct-connected generator sets, supplements Nos. 171 and 193. No. 195 describes the "A B C" "Economy" buffing hood, a new device for grinding and buffing wheels to recover the metal removed in grinding. The pamphlet No. 196, also 3⅝ x 6, describes "A B C" self-oiling engines. No. 200 is a 44-page illustrated sectional catalogue of the company's standard size, 7 x 8¾, on "Disc Ventilating Fans." Nos. 202 and 203 are on "Electric Disc Fans" and "Disc Ventilating Fans" respectively. They are two-leaf folders, 3⅝ x 6. All these publications are of the high standard of excellence characteristic of the advertising literature of this company.

*Reinforced Concrete and Fireproof Construction.*—The Trussed Concrete Steel Co., Detroit, Mich., is sending out in pamphlet form the advance sheets of Part I. of a volume entitled "Practical Calculation and Application of Reinforced Concrete." This first part is devoted to calculation. It is intended for the accurate and convenient use of practicing engineers and architects in calculating and designing reinforced concrete buildings. It contains formulae, tables, diagrams and drawings, and discusses the design of reinforced concrete beams, floor slabs, columns and footings and arch bridges. There are 31 pages.

Another pamphlet of equal size is on "Fireproof Construction." The contained matter is stated to be based on practical tests as set forth in official reports, including comments on the San Francisco disaster. Extracts from reports on the Baltimore fire are presented with illustrations, also an article on the fire resisting qualities of reinforced concrete. The contents are quite interesting. Both pamphlets are of pleasing design.

*The Denver & Rio Grande* has issued "A Glimpse of Utah, Where Health and Wealth Abound," an attractive booklet written by Edward F. Colborn. It treats of the early settlement of Utah; the Mormons and Gentiles; the natural wonders of the state; the wonderful climate, and Utah's growing cities and towns. The different resources and industries of the state are described under such heads as Agriculture, Fruit Growing, Stock and Wool Raising, Mining, Smelting and Manufacturing. The new Uintah Reservation, New Railroads and Hunting and Fishing also have short chapters. The book is illustrated by many excellent photographs.

*Coal Mining by Machinery.*—This is the title of a little 16-page pamphlet of the Sullivan Machinery Co., Chicago. It contains a brief summary of the line of equipment made for this special purpose, each device being illustrated by a half-tone engraving. Where the device is more fully described in some bulletin or catalogue the proper reference is given.

Bulletin 48-F of this company now being distributed describes the Sullivan continuous coal cutter. It is fully illustrated and explains in detail the characteristics, merits and advantages of the device.

*Mine and Quarry.*—The Sullivan Machinery Company, Chicago, has begun the publication of a quarterly bulletin or magazine bearing the above title. The object of the publication, as stated on the editorial page, is to familiarize its readers with the different classes of machinery made by the Sullivan Company. The initial number contains articles on "Rock Excavation at Panama," "Modern Methods at an Illinois Mine," "Diamond Drilling," "The Power Extension of the Chicago Drainage Canal," "Low Cost of Compressing Air for Drills," "Cleaving Granite by Compressed Air," and "Suggestions for Operation of Rock Drills." The magazine is 6 x 9, and its general style is excellent. The special front-cover design is printed in two colors, and the engravings and printing are of the best quality. The current number has 28 pages.

*The Pioneer Limited.*—The name of this famous train of the Chicago, Milwaukee & St. Paul furnishes the caption for an attractive publication by the passenger department of the road on the occasion of the meeting of the Federation of Women's Clubs in St. Paul, May 30 to June 7. Its four 7 x 11 pages contain a number of most artistic colored half-tones, and the letter-press is in brown. The front cover is printed in gold with an oval colored half-tone, in a gold frame, in the center.

*Walschaert Valve Gear.*—Record of Recent Construction, No. 55, issued by the Baldwin Locomotive Works, is devoted to a full description in detail of the Walschaert valve gear and its application to different types of locomotives. Special instructions for erecting and setting valves with this gear are given as well as a short discussion in regard to the advantages of the Walschaert gear over the Stevenson link motion.

### Manufacturing and Business.

Nic Le Grand, formerly Manager Supply Department of the St. Louis Car Co., has resigned, to take effect July 1st. He will go into the railroad supply business.

The Newton Fire Brick Co., Albany, N. Y., makers of locomotive blocks and fire bricks, have just completed a new plant at Albany, near to and operated in conjunction with their old plant. The capacity is from 10 to 12 carloads per week.

The Buda Foundry & Manufacturing Co., Chicago, has opened a branch house in St. Louis, Mo., and also established a warehouse there to expedite shipments of orders originating in that territory. The new branch will be in charge of W. E. Marvel, formerly a traveling representative.

The Bettendorf Axle Co., Davenport, Iowa, has begun work on large improvements to its plants. An additional building, nearly as large as the present shop structure, is to be built and much trackage added in the yard. The work will include the diversion of a creek now running through the site of the new building.

David O. Holbrook, until recently Vice-President of The Pennsylvania Malleable Co. and The Central Car Wheel Co., has been elected Vice-President of The Dayton Pneumatic Tool Company, Pittsburg, Pa., maker of Green chipping and riveting hammers. He has opened an office at 717 Park building, Pittsburg.

Application has been made in Pennsylvania for a charter by the Westinghouse Consolidated Foundries Company, of Pittsburg, Pa. The object is for the various Westinghouse Companies, which now have foundries at Pittsburg, Allegheny City, Cleveland and Attica, N. Y., to have all their castings made in one factory, which is located at Trafford City, near Pittsburg. This plan is to assure greater economy and uniformity in the making of foundry products.

## MEETINGS AND ANNOUNCEMENTS.

*(For dates of conventions and regular meetings of railroad conventions and engineering societies, see advertising page 24.)*

### Railroad Detectives' and Special Agents' Association.

This association, with 200 or more members present, held a convention at Washington, D. C., last week, beginning June 5. At this meeting the following officers were elected: W. A. Humphrey (N. Y. C.), Albany, N. Y., President; L. L. Scherer (Chesapeake & Ohio), Vice-President; H. C. Lards (Lake Shore & Michigan Southern), Second Vice-President; L. G. Crovier, Montreal, Third Vice-President, and C. H. Dawson, Aurora, Ill., Secretary and Treasurer. The Board of Managers consists of G. A. Ogline, Baltimore & Ohio; G. S. Fitzwater, Seaboard Air Line; W. G. Baldwin, Norfolk & Western; J. W. Connelly, Southern; W. F. Riley, Chicago & North-Western, and C. H. Dawson and W. A. Humphrey.

## ELECTIONS AND APPOINTMENTS.

### Executive, Financial and Legal Officers.

*Baltimore & Ohio.*—G. H. Pryor, Special Accountant, has been appointed Auditor of Disbursements, succeeding G. B. Howerth, resigned, to go into other business.

*Boyne City, Gaylord & Alpena.*—G. F. Moore has been appointed

Auditor, with office at Boyne City, Mich., succeeding Martin Reeder, transferred.

*Chicago, Burlington & Quincy.*—H. D. Foster, Auditor of Expenditures, has been appointed Auditor at Omaha, Neb., succeeding H. D. Allee, resigned, to go to another company. H. F. Evans succeeds Mr. Foster, with office at Chicago, Ill.

*Chicago, Indianapolis & Louisville.*—Byron Cassell has been elected Treasurer and Assistant Secretary, with office at Chicago, Ill., succeeding W. H. Lewis, deceased.

*Grand Trunk.*—A. A. Tisdale, who was recently appointed Assistant to the Fourth Vice-President, was born in 1874 at Mt. Vernon, Ont. His first railroad service was in 1889 as clerk in a freight office of the Grand Trunk at Hamilton, Ont. He remained in this office for three years, when he was made Secretary to the Chief Engineer of the Great Western, the Northern and Northwestern divisions of the same road. In 1896 he was made Secretary to the Chief Engineer to the whole road, and in 1899, Secretary to the General Superintendent. In 1902, he was appointed Secretary to the Manager, being promoted in a few months to the position as Chief Clerk to the Manager. From 1905 until his recent promotion he was Chief Clerk to the Fourth Vice-President.

*Long Island.*—David C. Green, Assistant Secretary, has been elected Vice-President, with office at Philadelphia, Pa.

*Minneapolis, St. Paul & Sault Ste. Marie.*—A. A. Bell has been appointed Auditor of Traffic Receipts.

*Ohio River & Western.*—G. P. Rogers has been appointed Auditor, with office at Woodsfield, Ohio, succeeding M. J. Howard.

*Washington & Columbia River.*—Joseph McCabe, Vice-President and General Manager, has resigned.

### Operating Officers.

*Boyne City, Gaylord & Alpena.*—M. E. Hotchkiss has been appointed General Superintendent.

*Central Vermont.*—W. E. Mullins, Superintendent of Transportation, has resigned, to become General Manager of the Costa Rica Railroad.

*Chicago, Rock Island & Pacific.*—H. L. Reed has been appointed Superintendent at Eldon, Mo., succeeding J. F. Sugrue, transferred.

*Georgia, Florida & Alabama.*—D. F. Kirkland, Trainmaster, has been appointed Superintendent of Transportation, with office at Bainbridge, Ga.

*Grand Trunk Pacific.*—M. C. Sturtevant, formerly Car Service Agent of the Grand Trunk, has been appointed General Assistant on the Grand Trunk Pacific, with office at Winnipeg, Man.

*Kansas City, Mexico & Orient.*—A. H. Dickinson, Assistant Superintendent, has been appointed Superintendent, with office at Wichita, Kan., succeeding J. A. Foley, deceased.

*National of Mexico.*—H. H. Allison has been appointed Superintendent of Terminals at the City of Mexico, succeeding D. R. Caffey, transferred.

*Pennsylvania.*—The office of A. P. Gest, Superintendent of the Belvidere division, has been moved from Lambertville, N. J., to Trenton.

*Philadelphia, Baltimore & Washington.*—The duties of the Superintendent of the Delaware division, formerly performed by R. L. Holliday, who died recently, have been taken over by E. F. Brooks, General Superintendent.

*Wabash.*—D. I. Forsyth, Acting Superintendent of Transportation, has been appointed Superintendent of Transportation, with office at St. Louis, Mo.

### Traffic Officers.

*Beaumont, Sour Lake & Western.*—A. V. Holmes, General Freight and Passenger Agent, has been appointed Superintendent and Traffic Manager.

*Boston & Albany.*—W. M. Skinner has been appointed General Baggage Agent, with office at Albany, N. Y.

*Boyne City, Gaylord & Alpena.*—G. F. Moore has been appointed Traffic Manager, succeeding H. H. Denison, resigned.

*Chicago, Burlington & Quincy.*—A. L. West has been appointed Assistant General Freight Agent at St. Joseph, Mo., succeeding William Fitzgerald, Jr., resigned.

*Erie.*—C. S. Ingersoll has been appointed Suburban Passenger Agent, with office at New York, succeeding E. H. Barto.

*Kansas City Southern.*—C. E. Perkins, Assistant General Freight Agent at Texarkana, Tex., and General Freight Agent of the Texarkana & Fort Smith, has been appointed Assistant General Freight Agent at Kansas City, Mo. R. R. Mitchell, General Agent at Shreveport, La., succeeds Mr. Perkins.

*Texarkana & Fort Smith.*—See Kansas City Southern.

### Engineering and Rolling Stock Officers.

*Beaumont, Sour Lake & Western.*—B. B. Gordon has been appointed Chief Engineer, succeeding M. A. Hanson, resigned.

*Chicago, Indiana & Southern.*—Byron Layton has been appointed Engineer of Maintenance of Way, with office at Hammond, Ind. W. R. Sanborn, Assistant Engineer, has resigned.

*Chicago, Rock Island & Pacific.*—W. L. Harrison, Master Mechanic at Horton, Kan., has been appointed Acting Superintendent of Motive Power at Chicago, Ill., succeeding J. P. Kilpatrick.

*Denver & Rio Grande.*—Arthur Ridgeway has been appointed Acting Engineer of Bridges and Buildings, with office at Denver, Colo., succeeding W. A. Morey.

*Long Island.*—G. C. Bishop has been appointed Superintendent of Motive Power and Equipment, with office at Richmond Hill, N. Y., succeeding Phillip Wallis.

*National of Mexico.*—C. L. Walker, Master Car Builder, has resigned.

*Pere Marquette.*—E. K. Woodward, Principal Assistant Engineer of the Wabash, has been appointed Chief Engineer of the Pere Marquette, succeeding J. F. Deimling, resigned, to go to another company.

*Wabash.*—E. M. Merriwether, Engineer of Maintenance of Way at Moberly, Mo., has been appointed Principal Assistant Engineer, with office at St. Louis, Mo., succeeding E. K. Woodward, resigned. J. T. Sheahan, master carpenter at Moberly, succeeds Mr. Merriwether. (See Pere Marquette.)

### Purchasing Agents.

*Georgia, Florida & Alabama.*—R. L. Uzzell, Assistant to the President, has been appointed Purchasing Agent, with office at Bainbridge, Ga.

*Wabash.*—C. A. How, Acting Purchasing Agent, has been appointed Purchasing Agent, with office at St. Louis, Mo.

## LOCOMOTIVE BUILDING.

*The Wisconsin Central*, it is reported, has ordered 10 locomotives from the American Locomotive Co.

*The Temiskaming & Northern Ontario* has ordered two switching locomotives from the Canadian Locomotive Co., for October delivery.

*The Lima Locomotive & Machine Co.* report the following orders for Shay locomotives for the week ending June 9: Pidgeon River Lumber Co., Pidgeon River, N. C., one 15 x 20 Prairie type locomotive; United States Leather Co., Medford, Wis., one 28-ton locomotive; Germain-Boyd Lumber Co., Atlanta, Ga., one 37-ton locomotive; Tremont Lumber Co., Tremont, La., two 55-ton locomotives; Bering Manufacturing Co., Houston, Tex., one 37-ton locomotive; Thornton & Alexandria Ry. Co., Thornton, Ark., one 14 x 20 ten-wheel locomotive, and Malvern Lumber Co., St. Louis Mo., one 33-ton locomotive.

*The Macon, Dublin & Savannah*, as reported in our issue of June 1, has ordered one simple switching locomotive from the Baldwin Locomotive Works, for July delivery. This locomotive will weigh 100,000 lbs.; cylinders, 18 in. x 24 in.; diameter of drivers, 50 in.; straight top boiler, with a working steam pressure of 180 lbs.; heating surface, 1,474.6 sq. ft.; 186 tubes, 2 in. in diameter and 14 ft. long; firebox, $71^{11}/_{16}$ in. x $34^{5}/_{16}$ in.; grate area, 17.12 sq. ft., and tank capacity, 2,500 gallons. The special equipment includes: Westinghouse-American air-brakes, magnesia sectional boiler lagging, Tower couplers, Monitor injector, U. S. metallic piston rod packings, Ashton safety valve and steam gages, Watters sanding devices, Nathan sight-feed lubricators, and Baldwin springs.

*The Western Allegheny* has ordered one consolidation (2-8-0) locomotive from the American Locomotive Co., for August delivery. This locomotive will weigh 202,000 lbs., with 180,000 lbs. on drivers; cylinders, 22 in. by 30 in., and drivers 54 in. in diameter. The boiler will be 80 in. in diameter, with a working steam pressure of 200 lbs. There will be 339 tubes, 2¼ in. in diameter, and 14 ft. 10 in. long; firebox, 120 in. by 40 in.; tank capacity, 7,000 gallons, and coal capacity, 1,300 tons. The special equipment includes: Westinghouse air-brakes, hammered iron or steel axles, Keasbey & Mattison magnesia sectional boiler lagging, Lappin brake-shoes and couplers, two Dressel herculean 5 in. lens headlight, Ohio injector, Chicago bull's-eye sight-feed lubricators, Union springs, and Ashton steam gages.

*The Mobile & Ohio*, as reported in our issue of May 18, has

ordered 10 simple 10-wheel (4-6-0) locomotives and five simple six-wheel switching (0-6-0) locomotives from the Baldwin Locomotive Works, for October delivery. The 10-wheel locomotives will weigh 170,000 lbs., with 130,000 lbs. on the drivers; cylinders, 21 in. x 28 in.; diameter of drivers, 68 in.; wagon top boiler, with a working steam pressure of 200 lbs.; heating surface, 2,944 sq. ft.; 361 Detroit seamless steel tubes, 2 in. in diameter and 15 ft. long; Otis steel firebox, $120^{3}/_{16}$ in. x $41^{7}/_{16}$ in.; grate area, 34.3 sq. ft.; tank capacity, 7,000 gallons, and coal capacity, 15 tons. The switching locomotives will weigh 138,000 lbs.; cylinders, 20 in. x 26 in.; diameter of drivers, 50 in.; straight top boiler, with a working steam pressure of 200 lbs.; heating surface, 1,919.2 sq. ft.; 325 Detroit seamless steel tubes, 2 in. in diameter and 10 ft. 5 in. long; Otis steel firebox, $108^{3}/_{16}$ in. x $41^{7}/_{16}$ in.; grate area, 30.8 sq. ft.; tank capacity, 5,000 gallons, and coal capacity, eight tons. The special equipment for both includes: Westinghouse air-brakes, Otis steel axles, Western bell ringer, Johns asbestos boiler lagging, Damascus brake-beams, Perfecto and Streeter brake-shoes, Gould couplers, Pyle-National headlights, Ohio injector, Ajax journal bearings, U. S. piston rod packings, Richardson valve rod packings, Consolidated safety valve, Leach sanding devices, Railway Steel-Spring Co.'s springs, Ashton steam gages, Safety steam heat equipment, Midvale driving, truck and tender wheel tires for passenger locomotives, and Paige truck wheel tires and Midvale tender wheel tires for switching locomotives.

*The Seaboard Air Line*, as reported in our issue of June 8, has ordered ten 10-wheel (4-6-0) passenger locomotives, and ten 10-wheel (4-6-0) freight locomotives from the Baldwin Works, and twenty 10-wheel (4-6-0) freight locomotives from the American Locomotive Works. All the locomotives are simple. The freight locomotives will weigh, including the tender, 265,050 lbs., with 125,300 lbs. on the drivers; cylinders, 19 in. by 28 in.; drivers, 60 in. in diameter. The passenger locomotives will weigh, including tender, 269,090 lbs., with 132,610 lbs. on drivers; cylinders, 20 in. by 28 in.; drivers, 67 in. in diameter. Other specifications for all locomotives are: Wagon top boiler, with a working steam pressure of 200 lbs.; 328 steel tubes, 2 in. in diameter and 14 ft. 1⅞ in. long, with a heating surface of 2,645 sq. ft.; firebox, 108 in. by 41¾ in., with a grate area of 31 sq. ft.; tank capacity, 5,000 gallons, and coal capacity, 10 tons. The special equipment for all locomotives includes: Westinghouse high-speed air-brakes, Machinery steel axles, Magnesia Sectional boiler lagging, Monarch Seaboard Air Line brake-beams, cast-iron brake-shoes, Tower steel couplers, Monitor injectors, Bronze journal bearings, U. S. Multi-Angular piston rod packings, Soapstone or Garlock valve rod packing, one open consolidated and one Coale's muffled safety valve, Leach sanding devices, Nathan sight-feed lubricators, Seaboard Air Line standard springs, Ashcroft or Starr steam gages, and steel driving wheel tires. For passenger locomotives, Pyle National Electric headlights, New York Safety steam heating equipment and steel truck and tender wheel tires. For freight locomotives, Seaboard Air Line standard headlights, cast-iron truck and tender wheel tires.

## CAR BUILDING.

*The Intercolonial* is in the market for 200 flat cars.

*The Missouri River & Northwestern* will soon be in the market for flat and box cars.

*The Hocking Valley*, it is reported, will shortly place orders for upwards of 3,000 freight cars.

*The New York Central & Hudson River* has ordered 1,500 gondola cars from the Pullman Co.

*The Armour Car Lines* are building at their shops the last 400 cars on their total order of 1,000 40-ft. fruit cars.

*The Mexican International* has ordered 100 stock cars of 80,000 lbs. capacity from the American Car & Foundry Co.

*The National R. R. of Mexico* has ordered 50 stock cars of 80,000 lbs. capacity from the American Car & Foundry Co.

*The Knickerbocker Ice Company*, Chicago, has ordered 50 gondola cars from the Pullman Co., to be built on New York Central specifications.

*The Cincinnati Northern* denies having ordered 20 closed cars for electric service from the Cincinnati Car Co., as reported in our issue of June 8th.

*The Harriman Lines* have ordered for the Southern Pacific 15 baggage cars from Barney & Smith and four observation smoking cars from the Pullman Co. for use on the Golden State Limited. All cars are for October delivery.

*The Texas Central* has ordered one coach and twenty 60,000 lbs. capacity flat cars from the Hicks Locomotive & Car Works. The flat cars will be 36 ft. long and 8 ft. 9 in. wide, over all. The special equipment includes: Westinghouse air-brakes, Tower couplers and Hinson draft rigging.

*The Gulf & Ship Island* has ordered 40 Hart convertible ballast cars of 80,000 lbs. capacity from the Rodger Ballast Car Co., for September delivery. The special equipment includes: American Steel Foundries bolsters, Lappin brake-shoes, Westinghouse brakes, R. E. Janney couplers, Miner draft rigging, Republic Railway Appliance Co.'s dust guards, Symington journal boxes, Simplex Railway Appliance Co.'s springs and American Car & Foundry Co.'s wheels.

*The Panama Railroad* has ordered three first-class passenger cars and 10 second-class passenger and four combination baggage and mail cars from the American Car & Foundry Co. for December delivery. All these cars will be 5 ft. gage, 61 ft. long, 10 ft. 4½ in. wide, and 6 ft. 10 in. high. They will be built of wood. The special equipment will include: M. C. B. steel axles, Streeter steel back brake-shoes, Westinghouse brakes for first-class passenger cars, and Janney-Buhoup couplers.

*The Erie*, as reported in our issue of June 8, has ordered 100 Hart convertible cars of 100,000 lbs. capacity from the Rodger Ballast Car Co., for January, 1907, delivery. These cars will weigh 43,000 lbs. and will be 40 ft. long, 8 ft. 8 in. wide, and 3 ft. 6 in. high, all inside measurements. They will be of wood, with steel underframes. The special equipment includes: Steel axles, Commonsense bolsters, Climax M. C. B. brasses and journal bearings, Miner tandem draft rigging, and American Car & Foundry Co.'s wheels.

*The Spokane & Inland* has ordered from the J. G. Brill Co. six combination baggage, smoking and passenger cars 58 ft. 8¾ in. long, 8 ft. 11 in. wide over sills and sheathing, 13 ft. high from rail over trolley board; six passenger motor cars 41 ft. long, 8 ft. 11 in. wide, and 13 ft. high, all outside measurements; six trailers, with observation ends, 41 ft. long by 8 ft. 11 in. wide and 13 ft. high, all outside measurements, and six express cars 50 ft. long and 8 ft. 6 in. wide, outside measurements.

*The Brooklyn Rapid Transit* has ordered 50 convertible passenger cars from the Jewett Car Co., and the same number from the Laconia Car Co. These cars have a seating capacity for 48 passengers. They will be 30 ft. 7¼ in. long, 7 ft. 7 in. wide, and 7 ft. 8⅜ in. high, all inside measurements. The body will be of wood, with ⅜ in. by 17 in. steel plate sides, and the underframes will be of wood. The special equipment includes: Buffalo Brake-Beam Co.'s brake-beams, Lappin brake-shoes, Curtain Supply Co.'s curtain fixtures, J. L. Howard & Co. door fastenings, double slide doors, Gold heating system, Symington journal boxes, vestibule platforms without side doors, B. R. T. standard monitor roofs, and Schoen solid rolled steel wheels.

*The Seaboard Air Line*, as reported in our issue of June 8, has ordered 1,000 box cars of 80,000 lbs. and 1,000 gondola cars of 80,000 lbs. capacity. The box cars will weigh 38,600 lbs., and will be 36 ft. long, 8 ft. 6 in. wide and 7 ft. 6 in. high, inside measurements, with wooden body and steel underframes. The gondola cars will weigh 36,600 lbs., and will be 37 ft. 6 in. long, 8 ft. 7 in. wide, and 8 ft. ⅜ in. high, all inside measurements, with wood and metal bodies and underframes. The special equipment up above includes: Open hearth steel axles, Pressed Steel bolsters, Seaboard Air Line standard brake-beams, cast-iron brake-shoes, Westinghouse brakes, Tower steel couplers, Seaboard Air Line standard draft rigging, wood dust guards, Symington journal boxes, Seaboard Air Line standard paint, springs and trucks; Dayton door fastenings, Seaboard Air Line standard doors, and Chicago old steel roofs for box cars.

## BRIDGE BUILDING.

Colorado Springs, Colo.—The Canon City & Royal Gorge Interurban Railway Co. has given contracts to the Bullen Bridge Co., of Pueblo, Colo., for putting up 15 iron bridges on its proposed line, now building to the top of Royal Gorge. The 150-ft. suspension bridge over the chasm, 2,800 ft. above the Arkansas river, may be built during the present summer.

El Paso, Tex.—Plans are being made by the Texas & New Orleans for building a viaduct in the east end of the city.

Michigan City, Ind.—The County Commissioners have approved the plans for the proposed bascule bridge for the harbor at Franklin street, and bids are to be asked for shortly. The cost of the work will be about $36,000.

Mineral Wells, Texas.—A contract has been let by the Commissioners' Court to John L. Moore for putting up three steel bridges at a cost of $12,300.

Muskogee, Ind. T.—Plans are being made for building a new bridge over the Arkansas river at Hyde Park, between Muskogee and Fort Gibson. The bridge is to be 1,300 ft. long, 50 ft. above

low water mark, and is to carry street cars. There will be approaches on each end of 1,000 ft. long.

NORFOLK, VA.—The Harbor Board will take applications from the Norfolk & Western to build bridges over the east and south branches of the Elizabeth river to replace the present structure. The War Department has already granted permission to build these bridges.

ROANOKE RAPIDS, N. C.—The stockholders of the Roanoke Rapids Bridge Co. at a recent meeting let a contract to the Roanoke Bridge Co., of Roanoke, Va., for building a steel and concrete toll bridge, with approaches over the Roanoke river. The cost of the work will be about $25,000.

VICKSBURG, MISS.—Plans are now under consideration for building a stone arch over the Alabama & Vicksburg tracks at Cherry street.

### Other Structures.

ALLOUEZ, WIS.—The Great Northern, it is said, will rebuild No. 1 ore dock and make it a duplicate of No. 2. The cost of the improvement is to be about $1,000,000.

BIRMINGHAM, ALA.—The Alabama & Western has given a contract to the Leonard-Martin Construction Co., of Chicago, for putting up a new brick and steel skeleton freight house, two stories high, 30 ft. by 342 ft., to cost $30,000, at Second avenue and Sixteenth street.

HAGERSTOWN, MD.—The Western Maryland will start work soon on new brick and steel shops, to include a blacksmith shop 50 ft. by 80 ft., repair shop 100 ft. by 240 ft., and a power plant 40 ft. by 40 ft., to cost, exclusive of the machinery, $75,000. Bids are now being received for the work at the office of the principal Assistant Engineer at Baltimore.

MONCTON, N. B.—Bids are wanted June 23 by the Intercolonial for building the first of its new car and machine shops to replace those destroyed by fire. The first building to be put up is to be a reinforced concrete car repair shop 630 ft. long by 132 ft. wide.

NEW ORLEANS, LA.—Work is shortly to be started on the New Orleans Terminal Co.'s passenger station at Basin street. It will cost about $175,000.

PORTSMOUTH, O.—J. P. Pettijohn & Co., of Lynchburg, Va., have been given a contract by the Norfolk & Western for putting up a new brick coach shop 66 ft. by 304 ft., to cost $16,500.

SAN FRANCISCO, CAL.—The Atchison, Topeka & Santa Fe has let contracts and work is now under way on its two large freight sheds at China Basin. The cost of the work will be about $300,000.

SEATTLE, WASH.—The Northern Pacific will build a modern wharf and warehouse to replace the burned Arlington wharf.

SPRINGFIELD, ILL.—The C., C., C. & St. L., it is said, will soon put up large car shops on a 24-acre tract of land near Lagonda. It is said that $500,000 has been appropriated for these improvements.

SYRACUSE, N. Y.—The Delaware, Lackawanna & Western has begun work on West Fayette street on a big coal trestle; estimated cost about $50,000.

TOLEDO, OHIO.—The Lake Shore & Michigan Southern, it is said, will build a large engine house and some shop buildings at a cost of about $500,000.

## RAILROAD CONSTRUCTION.

### New Incorporations, Surveys, Etc.

ALASKA PACIFIC RAILWAY & TERMINAL.—Dr. M. W. Bruner, of Alaska, the promoter of this company, incorporated to build from Controller Bay in Alaska through the Copper River country to Eagle City, about 450 miles, states that survey maps have been filed, and that construction work is to be started during the present year.

AMERICAN HAYTI CO.—Incorporated in New Jersey, with a capital of $3,000,000, to build railroads in the republic of Hayti. The incorporators are: A. S. Longbottom, William J. Merrill and Robert F. Bonner, all of Philadelphia.

ARIZONA MIDLAND.—The directors and stockholders of the Lake Superior & Arizona Mining Co., of Arizona, have organized a company under this name, with $500,000 capital, to build a railroad to connect the mine at Superior, Ariz., with the Gila Valley, Globe & Northern, about 28 miles. John T. Reeder, Chief Clerk of the Tamarac & Osceola Mining Co.; J. D. Cuddihy, A. W. Kerr, all of Calumet; H. L. Baer, of Hancock, and others are interested.

BOSTON ELEVATED.—There is pending in the Massachusetts Legislature (the House), not having passed the Senate, a bill to permit the Boston Elevated Railway Company to build subways in Cambridge. Under former legislation, the company has a right to build an elevated road in Cambridge. Since that legislation was passed, the people of Cambridge have changed their attitude and have made certain concessions to the company whereby it agrees to build a two-track subway instead of an elevated road. The company must begin to build within a year in order to preserve its rights under the act permitting an elevated road. The main route for the proposed subway is for the tracks to cross the new West Boston bridge (not yet open to travel) from the Boston to the Cambridge side of the Charles river, and then become a subway under Main street and Massachusetts avenue to Harvard Square. This is the route of the heaviest travel between Boston and Cambridge and cars would land passengers close by Harvard University. A short travel to Brattle Square is included. There is provision for subsequent construction from Central Square in Cambridgeport, which is about a mile east of Harvard Square, southwesterly under River street toward Brighton. Further provision is made for subsequent construction around the west side of Harvard University grounds and back easterly on Cambridge street to Boston, crossing over the new Charles river dam (which will be built with provision for a driveway on its broad surface and further room for car tracks on its downward slope), thence up Leverett, Brighton, Lowell and Causeway streets, by the north union station, and to a connection with the present elevated structure and the new Washington street subway, now under construction. Provision is also made for an extension of the subway in Cambridge under Webster avenue toward Somerville, so that that city can be included in the system eventually. The lines under Cambridge street, River street and Webster avenue may, under the terms of the bill, be begun at the option of the company any time within four years after the Main street line is put in operation. A referendum is permitted to the company on the acceptance of the act, but none is given to the city of Cambridge. After 20 years the city of Cambridge shall have the right (or before that time by agreement with the company) to buy the property, upon payment of the cost of construction and 7 per cent. simple interest per annum, deducting any dividends paid to the stockholders.

BUFFALO, LAKE ERIE & NIAGARA.—An officer writes that contracts are to be let as soon as a certificate has been granted by the New York State Board of Railroad Commissioners. The company proposes to build a connecting railroad around and just outside of the city of Buffalo, and to Tonowanda, passing through West Seneca, Hamburg, Cheektowaga, Amherst and Tonawanda; total length about 36 miles. The work will include about 3,000,000 cubic yards of embankment made from borrow pits, and 500,000 cubic yards of cuts; double-track to be laid and ballasted, bridges built on concrete foundations, and the necessary terminals, tracks and buildings. There is also to be a breakwater 4,800 ft. long, and a harbor, docks and slips. The maximum grades will be 1.14 per cent., and maximum curves of 10 per cent., though mostly 6 per cent. The bridge work includes 14 railroad bridges, three for use of electric cars, and 37 highway bridges. There will be five smaller bridges over streams, 18 farm bridges, 13 culverts, two pile trestles and one frame trestle. Edward Michael, 618 Mooney building, is President, and C. C. Conkling, 798 Ellicott avenue, Chief Engineer, both of Buffalo. (June 1, p. 160.)

CALIFORNIA & OREGON COAST.—An officer writes that prospects of building this road are very good. The proposed route is from Grant's Pass, Ore., on the Southern Pacific, southwest to Takilma via Loves, Wilderville, Selma and Kerby, 45 miles. Contracts for grading are to be let about the first of next month. The work is fairly light. The maximum grades are 2 per cent. and the maximum curvature is 8 deg. There will be one tunnel 730 ft. long, two bridges and 25 trestles. J. O'B. Gunn, Mechanics Savings Bank, is President, and J. W. M. Draper, Chief Engineer, San Francisco, Cal. (April 13, p. 114.)

CHICAGO, BURLINGTON & QUINCY.—An extension of the Lincoln division has been opened for business from Fremont, Iowa, northward to Hodge, 46.4 miles.

CHICAGO, ROCK ISLAND & PACIFIC.—The Chicago, Rock Island & Pacific Railway as lessee, effective June 1, operates as the Louisiana division of its Choctaw district that portion of the Rock Island, Arkansas & Louisiana Railroad between Haskell and Fordyce, Ark., and the line formerly known as the Arkansas Southern Railroad, whose northern terminus is at Eldorado, Ark., and which has now been extended southward as far as Grant, La.

COLUMBUS, NEW ALBANY & JOHNSTOWN TRACTION.—This company, operating a line from Columbus, Ohio, northeast to Gahanna, about nine miles, proposes to extend its line from the latter place to Johnstown, 17.5 miles additional. W. D. Brickell, Despatch Building, Columbus, is President.

DELAWARE & HUDSON.—An officer writes respecting the connecting line under construction from Rouse's Point, N. Y., to St. Constant, Que., on the Canadian Pacific, that this company is not build-

ing the line, but that it is being built by the Napierville Junction Railway Co., of Rouse's Point, N. Y. (June 1, p. 161.)

Durham & Charlotte.—This road, which runs from Gulf, N. C., on the Southern, to Star, 34 miles, has been extended from Star, N. C., to Little River, 3 miles.

Durham & Southern.—This road now runs from Dunn, N. C., west to Durham, 60.7 miles, having been recently extended from Apex, N. C., northwest to Durham, 20.3 miles.

Flint River & Gulf.—This new road has been opened for traffic from Ashburn, Ga., southward to Bridgboro, 32 miles. J. S. Betts, Ashburn, Ga., is President.

Georgia, Florida & Alabama.—The Quincy extension, which runs from Havana, Fla., westward to Quincy, 11.3 miles, has been opened for business. (May 18, 1906.)

Great Northern.—On Tuesday, June 12, the last rail was laid on the Sioux City-Ashland connection with the Burlington. (See Construction Record.)

Hillcrest Railway, Coal & Coke.—The bill to incorporate this company was ordered to be reported by the Railroad Committee. It proposes to incorporate a company with a capital of $500,000, and bonding powers to the extent of $30,000 a mile to build a railroad from Morrisey, B. C., via Crow's Nest Pass to Hillcrest Junction, on the Canadian Pacific, and Cardston, Alberta, with branch lines to Pincher Creek, and to certain local coal and oil fields.

Hudson River & Eastern Traction.—The New York State Board of Railroad Commissioners on June 11th granted a certificate of public convenience and necessity to this company to build from Ossining (Sing Sing), N. Y., east through Briarcliff Manor and Pleasantville to Sherman Park, nine miles.

Jonesboro, Lake City & Eastern.—The Osceola branch of this road, running from Dell, Ark., to Osceola, 19.5 miles, together with a two-mile branch from this line to Luxora, have been opened for traffic.

Las Vegas & Tonopah.—This road is now in operation for 73 miles from Las Vegas, Nev., on the San Pedro, Los Angeles & Salt Lake, via Indian Springs to a point called Johnnie.

Lee County.—Incorporated in Illinois with $10,000 capital to build a line from Nachusa west to Nelson, 13 miles. Both these places are on the Chicago & North-Western, and the new line is to be built to shorten the road between the places named. It is to be known as the Nelson cut-off. The incorporators are C. & N.-W. men, viz.: J. M. Whitman, M. Hughitt and J. B. Redfield, of Chicago; W. A. Gardner, of Evanston, and H. R. McCollough, of Lake Forest, Ill.

Leroy & Southern.—Incorporated in Illinois, with $2,000 capital and office at Bloomington, to build a line from Leroy in McLean County, southwest to Waynesville in Dewitt County, 25 miles. The incorporators are: A. H. Shelby and J. A. Taylor, of Bloomington; A. Hinton and L. A. Hinton, of Normal, and G. W. Shelby, of Wapella.

Live Oak, Perry & Gulf.—The Live Oak, Perry & Gulf Railroad now runs from Live Oak, Fla., to Hampton Springs, 49 miles, an extension having been put in operation from Perry, Fla., to Hampton Springs, 5 miles. Also a branch has been completed and opened for business which runs from Mayo Junction westward to Mayo and Alton, 14.3 miles.

Manila Railroad.—Incorporated in New Jersey with $100,000 capital by R. Schuster, of Speyer & Co.; W. F. Taylor and J. Rattray, of Hasbrouck Heights, N. J. Speyer & Co. have taken a contract to build railroads in the Philippine Islands, and it is believed that this company has been organized to carry out this work.

Napierville Junction Railway.—See Delaware & Hudson.

New York City Rapid Transit Routes.—The Commissioners appointed by the Appellate Division of the Supreme Court, composed of James A. Donnelly, Paul L. Kiernan and Julius G. Kremer, have filed a report favoring the construction of the proposed Van Cortlandt Park Rapid Transit route. The proposed route is an extension of the present west side subway system from Broadway, at 230th street, in the Bronx, north along Broadway to a point beyond 242d street and opposite the entrance to the park. This is to be an elevated structure, and will cost about $740,000.

Pittsburg & Lake Erie.—A contract has been given by this company to the Midland Steel Co., of Pittsburg, for the steel to be used on an extension of its road west to Midland, Pa.

Pittsburg & Tube City.—A franchise has been asked for in Pittsburg, Pa., by this company, which proposes to build a terminal line giving entrance to Pittsburg, to the Erie, the Pittsburg, Shawmut & Northern and other roads. The proposed route is from Try street and Fourth avenue east to the city line. Charles S. Cameron is chief promoter of the line, and former Senator Lee, counsel for the company; the latter says that the new line is to be an independent passenger and freight line, between Pittsburg and McKeesport. The cost of the work will be about $6,000,000. Plans and surveys have all been completed.

Pittsburg Subway.—Ordinances will be introduced in the Pittsburg Council during the present month authorizing this company to build a tunnel from Oliver avenue and Smithfield street to Center avenue near Luna Park, where connection is to be made with surface lines. The company proposes to spend about $20,000,000.

Pittsburg, Westmoreland & Somerset.—This road has been opened from Somerset, Pa., northwest to Ligonier. Connection is made at the latter place with the Ligonier Valley from Ligonier to Latrobe on the Pennsylvania. The new road shortens the distance from Somerset to Pittsburg about 40 miles, and was built to develop a large timber and coal section. It is supposed that it was built in the interests of the Goulds, and that it is to be extended south to Meyersdale, about 20 miles, where connection can be made with the Wheeling short line of the Wabash system.

Rio Grande, Sierra Madre & Pacific.—This company, it is said, will extend through the Sierra Madre Mountains southwest to Topolobampo on the Pacific Coast. Surveys are now being made by Chief Engineer J. P. Halihan. It is said that a route has been found through the Sierra Madre, and that the line will shortly be located. When built, this line will be a competitor of the Kansas City, Mexico & Orient to the west coast of Mexico.

San Saba Valley.—Contracts are soon to be let by this company for building its line. The proposed route is from Antelope Gap, on the Gulf, Colorado & Santa Fe, west to Crothers, about 50 miles. (June 1, p. 161.)

South Dakota Central.—This South Dakota road, which runs from Sioux Falls to Wentworth, 36 miles, has been extended from Wentworth to Rutland, 6.2 miles.

Southern.—A contract is reported let by this company to Edington & Griffith, of Knoxville, to build new yards at Asheville, N. C. The contract calls for removing 250,000 cubic yards of earth. The work is to be started shortly.

Sumter & Choctaw.—The Sumter & Choctaw Railway is now in operation from Bellamy, Ala., on the Southern, to Nix, 7 miles. It reaches mills and logging camps of the Allison Lumber Co., and is operated on irregular schedule for freight and passenger service. E. F. Allison, Bellamy, Ala., is President.

Southern Pacific.—This company has commenced the reconstruction of its South Pacific Coast branch, known as the "Narrow Gage," as far as Watsonville. The entire road through to Santa Cruz will be rebuilt at standard gage. The line will probably be widened as far as Boulder Creek within four months. Several tunnels will have to be widened.

Tidewater Development Co.—Incorporated in Alabama, with $100,000, by J. M. Dewberry, R. H. Little and J. W. Donnelly, with other capitalists of Birmingham and Tuscaloosa. The company proposes to establish and operate steamship lines on the Warrior, Tombigbee, Alabama, Coosa, Mobile and other rivers and to build electric railroads and power stations in Alabama. Franchises have already been secured for building an electric line from Tuscaloosa to Gadsden through Birmingham. The company expects to build numerous other similar lines in the state. J. M. Dewberry is President; Lewis Miller, Vice-President, and J. W. Donnelly, Secretary.

Wabash.—This company after a five years' campaign has secured an entrance into profitable Pittsburg freight territory by completing a connection with the Union Railway. The Wabash-Pittsburg terminal is four miles long from the West Side Belt Railway, a local switching road, at a point one mile east of Castle Shannon, to the head waters of Thompson's Run. At this point, the junction of this new line with the Monongahela Southern Railroad, a yard is being built. The M. S. is a subsidiary company of the United States Steel Corporation. It is seven miles long, and extends to a connection on the Monongahela river at Duquesne with the Union Railroad of the United States Steel Corporation. The line just completed gives the Wabash an entry into the mills of the Carnegie Steel Co., and enables it to secure the percentage of the company's shipments, which was agreed upon before the absorption of the Carnegie Company by the United States Steel Corporation.

Western Pacific.—Petition has been made by this company to the San Francisco Board of Supervisors for a 46½-year franchise. The company is prepared to begin construction as soon as permission to do so has been granted. The route applied for connects with the line of the franchise asked for three years ago at a point on the water front near Twenty-fifth street and parallel with the latter thoroughfare to Indiana street. It then turns northwesterly through a tunnel in the Potrero hills to the Ninth and Brannan streets terminal. It is said that the change in the plans for that

portion of the line first applied for was on account of the Ocean Shore road having recently secured a franchise on practically the same route. The proposed line begins on the water front at Twenty-fifth street. Other streets to be traversed are: New York, Indiana, Iowa, Pennsylvania avenue, San Bruno avenue, Channel street and Brannan street.

WISCONSIN & NORTHERN.—Incorporated with $1,000,000 capital in Wisconsin to build from Menasha, Wis., on the Minneapolis, St. Paul & Sault Ste. Marie north to a point near Crandon Junction through Winnebago, Outagamie, Shawano, Langlade and Forest Counties, approximately 125 miles; much of the right of way has been secured. J. S. Jones and H. C. Adams, of Chicago; M. D. Keith and S. Shore, of Crandon; M. J. Walreck, Shawano; R. H. Edwards, of Oshkosh, and others, are interested.

## RAILROAD CORPORATION NEWS.

CHICAGO & ALTON.—This company, which is a reorganization of the Chicago & Alton Railroad and the Chicago & Alton Railway, effected a few months ago, has declared its initial dividend of 2 per cent. on the $899,300 cumulative preferred stock and 2 per cent. on the $19,557,900 4 per cent. non-cumulative preferred stock to stockholders of record June 15, 1906.

CHICAGO RAILWAYS CO.—This company, incorporated several years ago with $10,000 capital stock, has been organized with F. H. Rawson, President of the North Chicago Street R. R. and of the West Chicago Street R. R., as President, and H. H. Blain, receiver of the North and West lines, as Vice-President and G. E. Adams, H. H. Blain, J. H. Eckels, W. N. Eisenbrath, J. W. Gary, F. H. Rawson and one other to be named later, as directors. This company, it is expected, will take over the holdings of the Chicago Union Traction in the securities of the North Chicago Street R. R. and the West Chicago Street R. R., both of which are leased to the Chicago Union Traction. It is to issue $50,000,000 4 per cent. bonds, which will be used to retire $17,000,000 outstanding of the total authorized issue of $30,000,000 Illinois Tunnel Co. first mortgage 5 per cent. bonds of 1928 and to refund other issues.

CHICAGO UNION TRACTION.—(See Chicago Railways Co.)

CLEVELAND, PAINESVILLE & ASHTABULA (ELECTRIC).—See Cleveland, Painesville & Eastern.

CLEVELAND, PAINESVILLE & EASTERN (ELECTRIC).—This company, which has outstanding $1,606,000 capital stock and $1,402,000 bonds, has acquired two-thirds of the $1,000,000 outstanding capital stock of the Cleveland, Painesville & Ashtabula at a price said to be $20 a share. The C., P. & E. has trackage rights over the Cleveland Electric from Cleveland, Ohio, to Euclid. It owns 23 miles of road from the last-named place eastward along the shore of Lake Erie to Painesville, where it connects with the C., P. & A., which operates 30 miles of road from Painesville east to Ashtabula.

DES MOINES & FORT DODGE (M. & ST. L.).—The shareholders have approved the authorized issue of $1,000,000 5 per cent. second mortgage bonds of 1935. They also voted to increase the common stock from $4,283,100 to $5,335,600 and the preferred from $763,500 to $1,164,400. (June 1, p. 162.)

INTERBOROUGH RAPID TRANSIT.—A quarterly dividend of 2¼ per cent. has been declared payable to stockholders of record on June 20 on the $35,000,000 common stock. Since July, 1905, the quarterly dividend has been 2 per cent. With this stock on a 9 per cent. annual dividend basis, the shareholders who did not exchange their holdings for the 4½ per cent. Interborough-Metropolitan bonds do not seem to lose by their non-participation.

MINNEAPOLIS & ST. LOUIS.—See Des Moines & Fort Dodge.

NEW HAVEN & NORTHAMPTON.—This company, which is leased by the New York, New Haven & Hartford, which owns its entire capital stock, has made a mortgage to the Treasurer of the State of Connecticut, trustee, to secure an issue of $10,000,000 4 per cent. bonds of 1956, guaranteed by the N. Y., N. H. & H. The purpose of this issue is as follows: $2,000,000 to reimburse the N. Y., N. H. & H. for the redemption several years ago of that amount of N. H. & N. bonds; $1,900,000 to refund at maturity bonds falling due in 1909 and 1911, and the remainder for double-tracking, elimination of grade crossings and improvements in New Haven and at other places.

NEW YORK CITY RAILWAY.—The report for the quarter ended March 31 shows a distinct improvement over the corresponding quarter of 1905. Gross earnings were $3,960,771, an increase of $321,304. The operating expenses decreased $68,916, leaving net earnings $1,562,313, an increase of $390,220. After interest and other charges, including the 7 per cent. guaranteed dividend on the $52,000,000 capital stock of the Metropolitan Street Railway Co. (the lessor of the road), the deficit amounted to $926,367 as compared with a deficit during the corresponding quarter of 1905 of $1,322,406.

NEW YORK, NEW HAVEN & HARTFORD.—(See New Haven & Northampton.

PENNSYLVANIA COMPANY.—A semi-annual dividend of 3 per cent. has been declared on the $60,000,000 outstanding stock. The annual dividends paid in December, 1904, and December, 1905, were 5 per cent., and in 1903 and 1902, 4 per cent.

PERE MARQUETTE.—The car ferry lines between Ludington, Mich., Kewaunee, Manitowoc and Milwaukee, Wis., formerly operated by the Pere Marquette Steamship Company, are now operated by the Pere Marquette Railroad.

PHILADELPHIA CO.—A meeting of the shareholders of this company, recently sold to the United Railways & Investment Co. of San Francisco, has been called for August 14 to authorize an increase in the common stock from $30,000,000 to $36,000,000. The proceeds will be used to reimburse the company for the purchase of the capital stock of the Beaver Valley Traction Co. and the Washington & Hammondsburg. The remainder will be used to provide additional power facilities for the Allegheny County Light Co. and the Pittsburg Railways Co., and for other improvements and expenses.

PITTSBURG, CINCINNATI, CHICAGO & ST. LOUIS.—A semi-annual dividend of 2½ per cent. has been declared on the $27,456,099 preferred stock. The previous dividend was 2 per cent., the rate paid semi-annually since 1899.

SEABOARD AIR LINE.—It is reported that this company intends to consolidate some of the coal companies controlled by it. The Clinchfield Coal Corporation is being organized with $10,000,000 capital stock to take over the Cranes Nest Coal & Coke Co., the Dawson Coal & Coke Co., and the Clinchfield Coal Co., controlling, it is said, about 350,000 acres of coal land. Another company, the Cumberland Corporation, is to control the Clinchfield Corporation, and also the South & Western Railroad, now in operation from Johnson City, Tenn., to Sprucepine, N. C., and building to connections with the S. A. L. and other roads.

SOUTHERN.—Lee, Higginson & Co., Boston, are offering, at a price to yield 4½ per cent., $9,000,000 4½ per cent. equipment trust certificates due in semi-annual instalments from August 1, 1906, to February 1, 1921, inclusive. These certificates are secured by a mortgage to the Fidelity Trust Co., Philadelphia, as trustee, of 100 locomotives and 10,000 freight cars.

VELASCO, BRAZOS & NORTHERN.—The foreclosure sale of this 20-mile Texas road will take place on July 3. (June 1, p. 162.)

WABASH.—The directors have approved of a plan for the redemption of the $26,500,000 outstanding debenture "B" 6 per cent. non-cumulative bonds. No interest has ever been paid on these bonds, and about a year ago a protective committee was formed to determine the rights of the bondholders, since it was understood that the net earnings of the company had been used for improvements so that there was no surplus available to pay the interest on these bonds, which are a prior lien upon the main line from Toledo to Chicago, and from Chicago to St. Louis. Negotiations were entered into with the company, and it has finally agreed, subject to ratification by the shareholders, of a plan, the substance of which is as follows: The Wabash is to issue about $200,000,000 4 per cent. consolidated mortgage bonds; the debenture B's are to be exchanged for 70 per cent. of their face value in these new bonds, 50 per cent. in common stock, and 50 per cent. in preferred stock. The directors have referred the matter to the committee, who will put the plan in shape to present it at a shareholders' meeting to be called later. It is understood that the Gould interests control about $15,000,000 of the outstanding debenture B's. The new bond issue will also be used to retire the $3,500,000 debenture A bonds, and for other purposes. To carry out the above plan, it will be necessary to issue $13,250,000 new preferred stock.

WISCONSIN CENTRAL.—This company has filed amended articles of incorporation giving it power to take over the Owen & Northern and the Lake Superior & South-Eastern. The first-named company has completed 42½ miles of road from Owen, Wis., northwest to Ladysmith, and the other company has under construction 112 miles of road from Ladysmith to Duluth.

This company has sold to a syndicate of bankers $7,000,000 Superior and Duluth division and terminal first mortgage 30-year 4 per cent. bonds.

YOUNGSTOWN & OHIO RIVER.—The Pittsburg, Lisbon & Western, a subsidiary company of the Wheeling & Lake Erie, has leased that part of its line extending from Salem, Ohio, to a connection with the Erie Railroad at Washingtonville, Ohio, to the Youngstown & Ohio River Railroad, which now operates this line. A meeting of the stockholders has been called to increase the authorized capital stock from $10,000 to $1,700,000.

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# RAILROAD GAZETTE



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## ALPHABETICAL INDEX TO ADVERTISERS.

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## ALPHABETICAL INDEX TO ADVERTISERS.



## DIRECTORY OF ADVERTISMENTS, CLASSIFIED.

**AIR BRAKES**
Westinghouse Air Brake Co., Pittsburg, Pa.

**AIR BRAKE FITTINGS**
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(See Hose, Air, Steam, etc.)

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(See Pneumatic Hoists.)

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(See Journal Bearings.)

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King Bridge Co., The, Cleveland, O.
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Elliot Frog & Switch Co., E. St. Louis, Ill.
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Interstate Engineering Co., Cleveland, O.
King Bridge Co., Cleveland, O.
Lambert Hoisting Engine Co., Newark, N. J.
Lidgerwood Mfg. Co., New York, N. Y.
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Link-Belt Machinery Co., Chicago, Ill.
McMyler Mfg. Co., Cleveland, O.
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American Locomotive Co., New York, N. Y.
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Hunt Co., C. W., New York, N. Y.
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**LOCOMOTIVE SWITCH ROPES**
(See Rope.)

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Morse Twist Drill & M. Co., New Bedford, Mass.
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Dixon Crucible Co., Jos., Jersey City, N. J.
Franklin Railway Supply Co., Franklin, Pa.
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Vulcan Iron Works, Chicago, Ill.
Vulcan Iron Works, Toledo, O.

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Stow Mfg. Co., Binghamton, N. Y.
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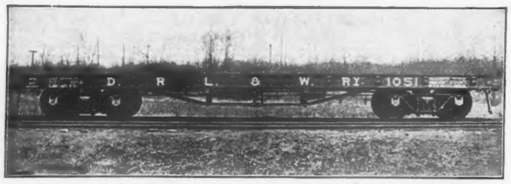


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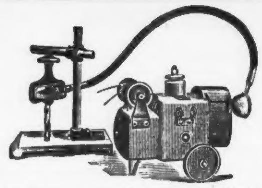

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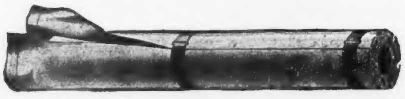

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**American Railway Master Mechanics' Association.**—The 1906 meeting will be held at Atlantic City, N. J., June 18-20. J. W. Taylor, Secy., 390 Old Colony Bldg., Chicago, Ill.

**Association of American Railway Accounting Officers.**—The Next annual meeting will be held at Bluff Point, N. Y., June 27, 1906. C. G. Phillips, Secretary, 143 Dearborn St., Chicago, Ill.

**Association of Railway Telegraph Superintendents.** — The annual meeting of this Association will be held at Denver, Colo., June 20, 1906. P. W. Drew, Secretary (Wis. Cent.), Milwaukee, Wis.

**Master Car Builders' Association.**—The 1906 meeting will be held at Atlantic City, N. J., June 13-15. Jas. W. Taylor, Sec., 390 Old Colony Bldg., Chicago, Ill.

**Railway Signal Association.**—Meets second Tuesday in January, March, May, September and October. H. S. Balliet, Sec., Grand Central Station, New York City.

**Train Dispatchers' Association of America.**—The next convention of this Association will be held at Buffalo, N. Y., June 19, 1906. J. F. Mackie, Secretary (C., R. I. & P.), Chicago, Ill.

### RAILROAD CLUBS.

**Canadian Railway Club.**—Meets at the Windsor Hotel, Montreal, Que., on the first Tuesday of each month at 8 p. m., excepting June, July and August. James Powell, Sec., P. O. Box 7, St. Lambert, P. Q.

**Car Foremen's Association of Chicago.**—Meets on the second Monday of each month at 8 p. m., 26 Van Buren Street. Aaron Kline, Secretary, Chicago, Ill.

**Central Railway Club.**—Meets at the Hotel Iroquois, Buffalo, N. Y., on the second Friday of January, March, May, September, and November, at 2 p. m. Harry D. Vought, Secretary. 62 Liberty St., New York.

**Iowa Railway Club.**—Meets on the second Friday of each month at place announced at previous meeting. W. B. Harrison, Sec. (Union Station), Des Moines, Iowa.

**New England Railroad Club.**—Meets at Pierce Hall, Copley Square, Boston, Mass., on the second Tuesday of each month, except June, July, August and September. Edward L. Janes, Secretary, South Terminal Station, Boston, Mass.

**New York Railroad Club.**—Meets on the third Friday of each month at 8 p. m., excepting June, July and August, at 154 West 57th Street (Carnegie Hall). Harry D. Vought, Secretary, New York City.

**Pacific Coast Railway Club.**—Meets in San Francisco, Cal., on the third Saturday of each month. C. C. Borton (S. P. Co.), Sec., West Oakland, Cal.

**Railway Club of Pittsburg.**—Meets at Monongahela House, at 8 p. m. on the fourth Friday of each month, except June, July and August. J. D. Conway, P. & L. E. R. R., Pittsburg, Pa., Secretary.

**Railway Water Supply Association.**—Meets on the first Sunday of each quarter at Alexander Hall, South Minneapolis, Minn. F. W. Hayden, Secretary, Glencoe, Minn.

**Richmond Railroad Club.**—Regular meetings are held on the second Thursday in each month except June, July and August, at 8 p. m., in Richmond, Va. F. O. Robinson, Chesapeake & Ohio Ry., Richmond, Secretary.

**Southern & Southwestern Railway Club.**—Meets at the Kimball House, Atlanta, Ga., on the third Thursday, in January, April, August and November. W. A. Love, Secretary, Atlanta, Ga.

**St. Louis Railway Club.**—Holds its regular meeting on the second Friday of each month, except July and August, at 3 p. m. E. A. Chenery, Secretary, Fourth Floor, Union Station, St. Louis.

**Texas Railway Club.**—Meets on the third Monday in April and September at place and time chosen at the previous meeting. T. H. Osborne, Secretary, Pine Bluff, Ark.

**Western Railway Club.**—Meets on the third Tuesday of each month except June, July and August, in the Auditorium Hotel, Chicago, Ill. J. W. Taylor, Secretary, 390 Old Colony Building, Chicago.

### ENGINEERING SOCIETIES.

**American Institute of Electrical Engineers.**—Meets at 12 West 31st Street, New York, on the fourth Friday of each month, except June, July and August. Ralph W. Pope, Sec., 95 Liberty Street, New York.

**American Society of Civil Engineers.**—Meets at the house of the Society, 220 West 57th Street, New York City, on the first and third Wednesday in each month, at 8:30 p. m., except in July and August. C. W. Hunt, Secretary, 220 W. 57th Street, New York.

**Boston Society of Civil Engineers.**—Meets at Chipman Hall, Tremont Temple, Boston, on the fourth Wednesday in January and on the third Wednesday of the other months, except July and August. S. E. Tinkham, Sec., 60 City Hall.

**Civil Engineers' Society of St. Paul.**—Meets on the second Monday of each month. G. E. Edmonstone, City Bridge Engineer, St. Paul, Minn., Sec.

**Canadian Society of Civil Engineers.**—Meets at its rooms, 877 Dorchester Street, Montreal, P. Q., every alternate Thursday, at 8 p. m., from October to May, inclusive. C. H. McLeod, Sec.

**Civil Engineers' Club of Cleveland.**—Meets at 1200 Schofield Building, Cleveland, Ohio, on the second Tuesday in each month, at 8 p.m. Semi-monthly meetings are held on the fourth Tuesday of each month. J. C. Beardsley, Secretary, 1200 Schofield Building.

**Engineering Association of the South.**—There are two local sections of this Association. The Birmingham, Ala., section meets on the first Thursday of every month. G. H. Harris (Birmingham St. Railway), Sec. The Nashville, Tenn., section meets on the third Monday of each month. John Wilkes, Berry Block, Nashville, Sec. The headquarters of the general Association is at Nashville. The annual meeting will be held in December.

**Engineers' Club of Chicago.**—Meets on the first and third Tuesday evening of each month in Jefferson Hall, 70 Adams Street. B. W. Thurtell, Sec., 1223 New York Life Building, Chicago.

**Western Society of Engineers.**—Meets On the first Wednesday, and generally on the third Wednesday of the month, except January, July and August, at 8 p. m., at 1737 The Monadnock, Chicago. Electrical Section meets on the second Friday of each month, October to May, inclusive, at 8 p. m. J. H. Warder, Sec.



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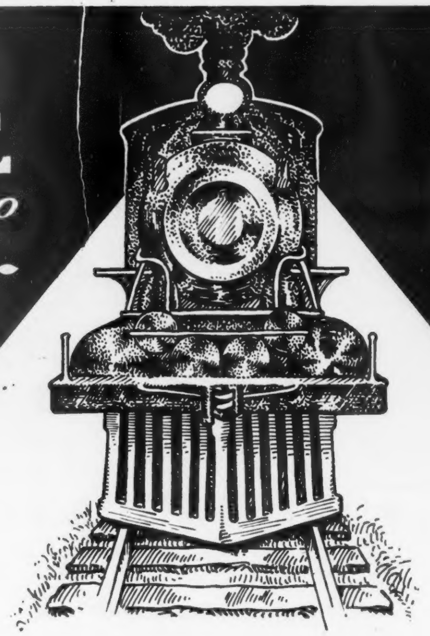

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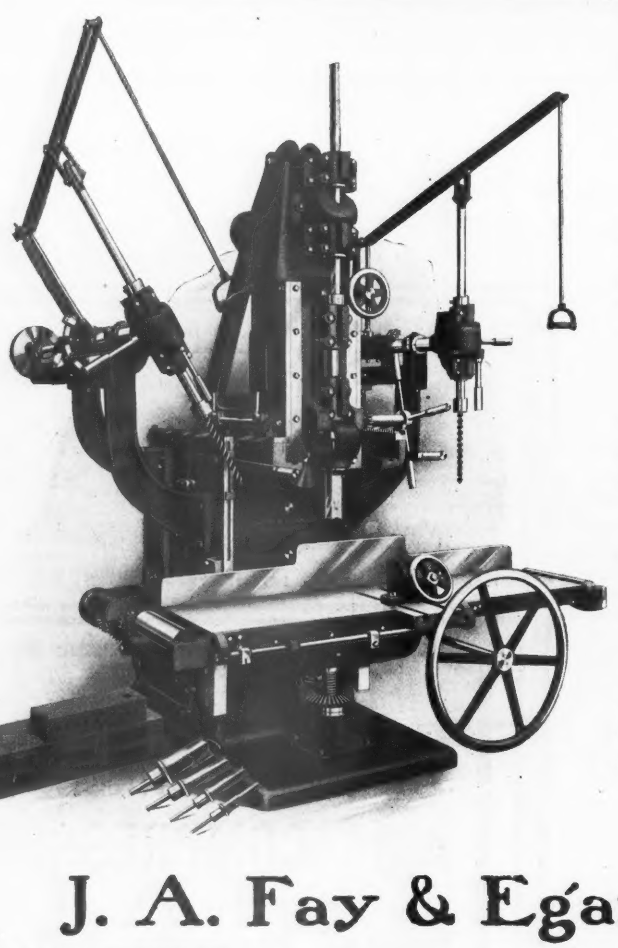

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# THE Crescent Angle Band Saw

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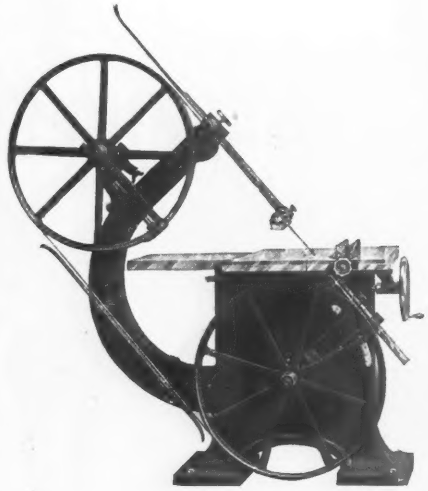

Cuts any angle up to 45 degrees with **Table Always Level.** To change angle of saw, turn hand wheel at side of table—that's all; no other adjustments necessary.

Blade can be tilted while in motion.

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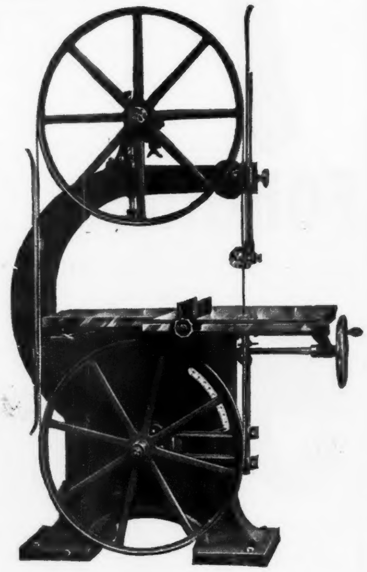

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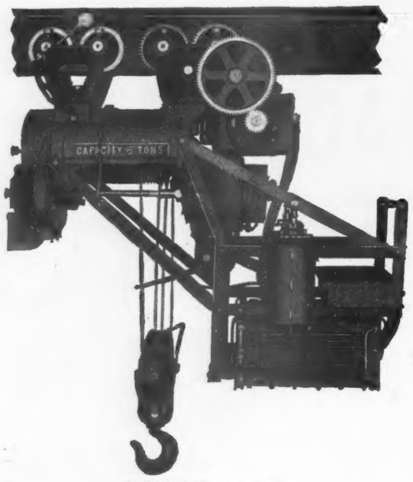
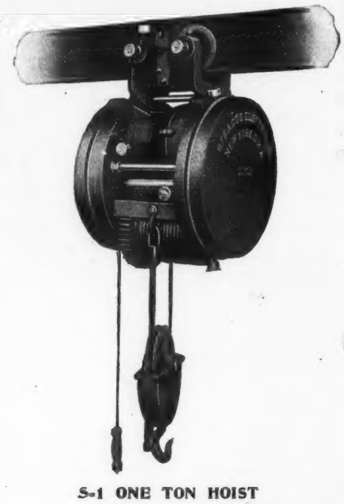



MONORAIL CRANE



S-1 ONE TON HOIST

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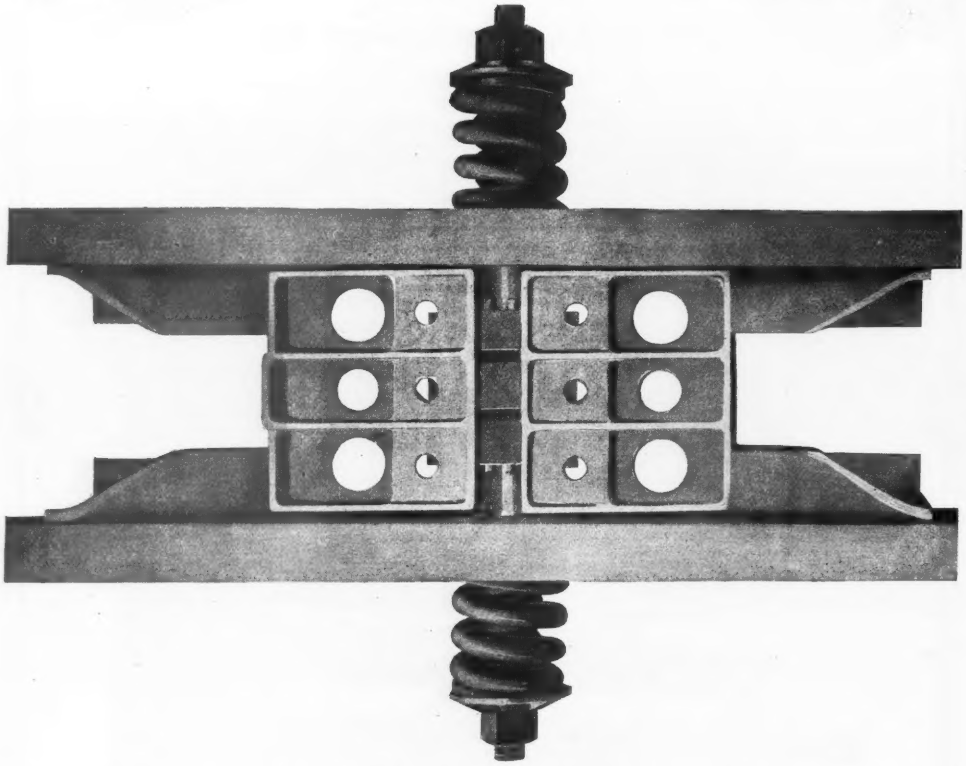

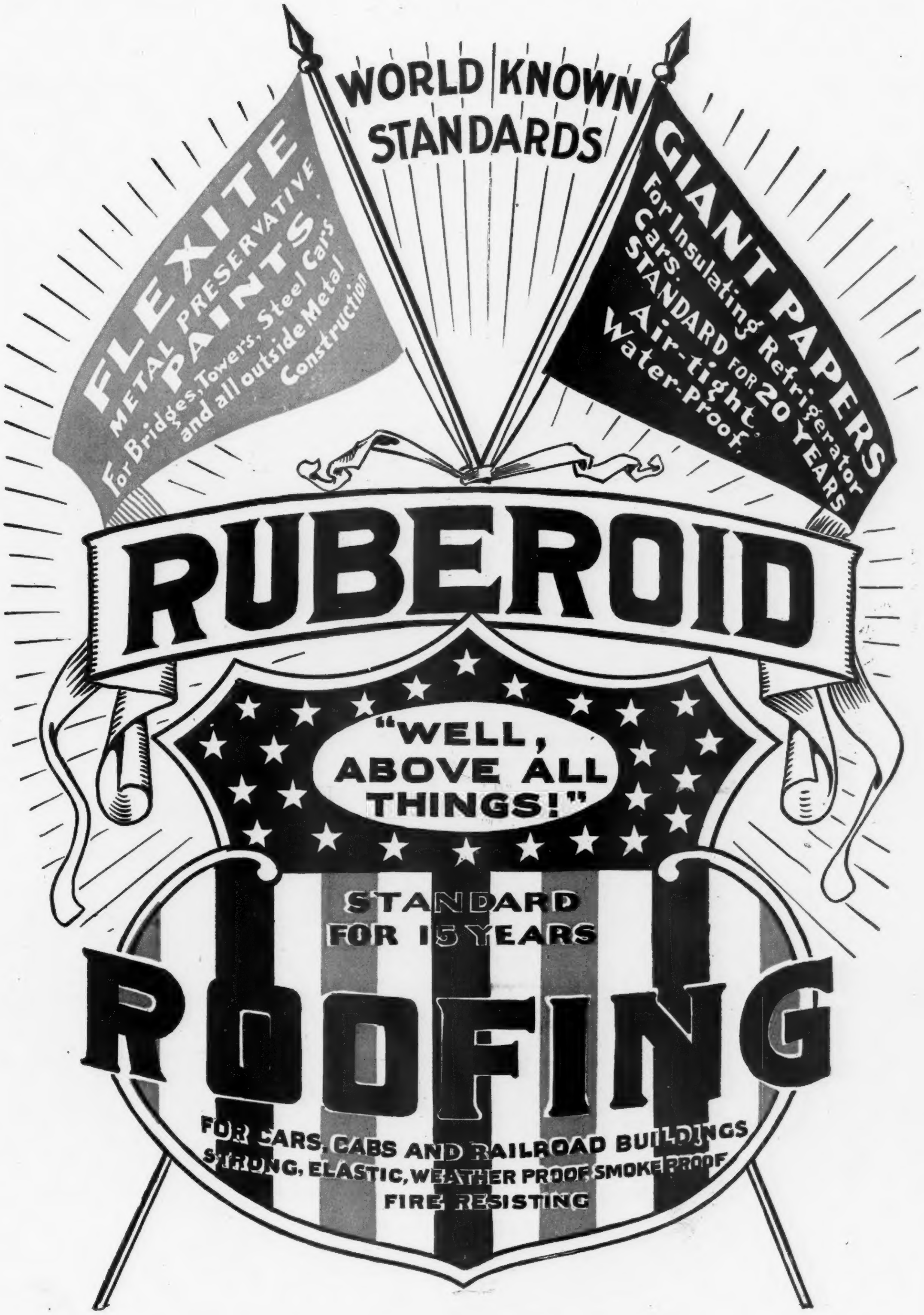
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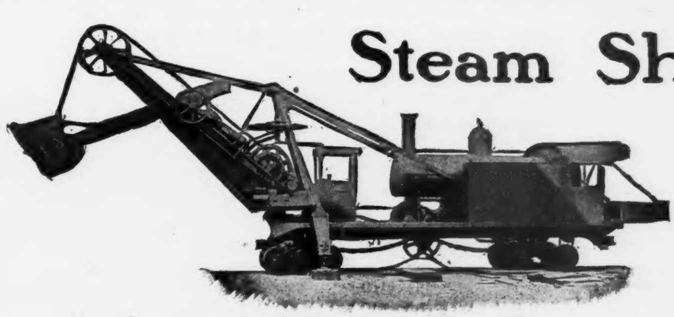

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